



This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

- + *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
- + *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
- + *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
- + *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at <http://books.google.com/>

THE APPLETON ARITHMETICS



SECOND
BOOK

WITH
ANSWERS

EducT 119.11.890 Bk2



THE LIBRARY
OF THE
ESSEX INSTITUTE

PRESENTED BY

Sidney Purley

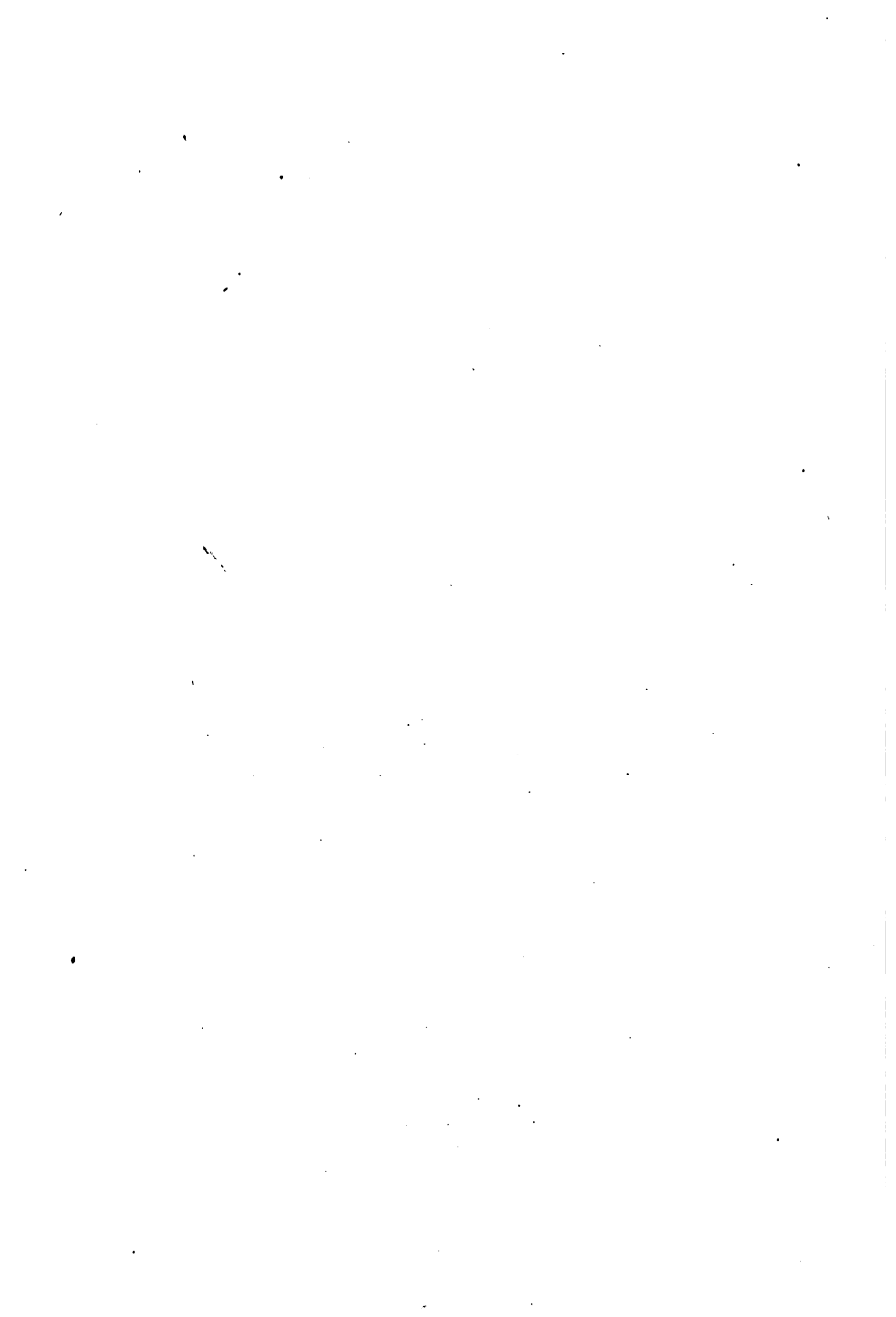
Received

Nov 27, 1912

HARVARD COLLEGE
LIBRARY



3 2044 097 007 082



THE APPLETON ARITHMETICS

BY

J. W. A. YOUNG, PH.D.

ASSOCIATE PROFESSOR OF THE PEDAGOGY OF MATHEMATICS
THE UNIVERSITY OF CHICAGO

AND

LAMBERT L. JACKSON, PH.D.

FORMERLY PROFESSOR OF MATHEMATICS, STATE NORMAL SCHOOL
BROCKPORT, NEW YORK

SECOND BOOK



NEW YORK
D. APPLETON AND COMPANY

1911

EdueT 119.11.890 B 42

HARVARD COLLEGE LIBRARY
GIFT OF
GEORGE ARTHUR PLIMPTON
JANUARY 25, 1924

COPYRIGHT, 1909, BY
D. APPLETON AND COMPANY

P R E F A C E

THE present volume of THE APPLETON ARITHMETICS covers the work usually taught in the fifth and the sixth grade, beginning with a brief review of the work of the primary grades, and then providing a course that covers the essentials of elementary arithmetic.

Like the other Books, this text is for the *pupils'* use, and as such possesses certain well-defined features. Important definitions, principles, and processes are introduced inductively by means of a series of questions and illustrations labeled "Preparatory." A natural and easy approach to the subject is thus provided for the pupil, without, however, placing hard and fast limitations on the teacher's method. When a principle or process has been developed and stated, it is put into practice through easy Oral Exercises which are followed by Written Exercises, of gradually increasing difficulty and including applications that require somewhat extended calculations.

In addition to giving proper attention to the culture value peculiar to the exact reasoning of school mathematics, this book fully recognizes the utility of arithmetic. The problem material is rich in data drawn from the pupil's experience. School subjects like manual training, domestic art, geography, nature study, and drawing have furnished many problems; and the everyday occupations and industries of the average community

are made to contribute their share of applications. Finally, the larger interests of the community, such as production, transportation, communication, and government, have not been neglected as sources for problems of interest and value.

In all of this, arithmetic is made the subject of study and the core of the instruction, without, however, sacrificing the pupil to abstract number drill; and the whole subject is classified and labeled in harmony with a logical development.

It is thought that the classroom work will be facilitated by the oral and written work, properly labeled; the well-balanced abstract and concrete drill; the frequent and systematic reviews; the classified tables of measurement, and the attempt to supplement and strengthen the text by careful typography and effective illustration.

THE AUTHORS.

CONTENTS

	PAGES
REVIEW AND PREPARATION.....	1-14
Notation and Numeration.....	1
Addition and Subtraction.....	2
Multiplication.....	4
Division.....	5
Common and Decimal Fractions.....	6
Denominate Numbers.....	8
Business Arithmetic.....	10
PROBLEMS	10
 CHAPTER I: PROCESSES WITH INTEGERS.....	 15-58
Notation and Numeration.....	15
Addition.....	17
Subtraction.....	20
Making Change.....	22
Multiplication.....	25
By 10 and by 100.....	27
Multipliers Containing Zeros	28
Dollars and Cents.....	29
Powers.....	30
Division.....	32
By 10 and by 100.....	35
Long Division.....	37
Cash Accounts.....	40
Money Orders.....	42
Keeping Store.....	44
Postage Problems.....	46
Factors and Multiples.....	47
Divisibility.....	47
Factors and Divisors.....	48
Common Divisors.....	49
Multiples.....	51
Cancellation.....	53
REVIEW.....	54
 CHAPTER II: COMMON FRACTIONS.....	 59-98
Comparison.....	63
Reduction.....	64
To Higher or Lower Terms.	64
To a Common Denominator.	67
Addition and Subtraction.....	69
Addition.....	69
Subtraction.....	71
Mixed Numbers.....	73

	PAGES		PAGES
Multiplication	77	Division (<i>continued</i>)	
A Fraction by an Integer...	77	A Fraction by an Integer..	89
An Integer by a Fraction...	79	With Mixed Numbers.....	90
A Fraction by a Fraction...	81	To Find What Part One	
With Mixed Numbers.....	83	Number Is of Another...	91
Division	86	To Find the Whole When a	
Unity by Any Fraction.....	86	Fractional Part Is Given	92
Any Integer by a Fraction..	87	Complex Fractions.....	93
A Fraction by a Fraction..	88	REVIEW	94

CHAPTER III: DECIMAL FRACTIONS..... 99-120

Notation and Numeration	99	Division	111
Tenths and Hundredths...	99	A Decimal by an Integer..	111
Thousandths.....	101	A Decimal by 10 and by	
Addition and Subtraction	103	100.....	112
Multiplication	105	Reduction	114
A Decimal by an Integer..	105	A Decimal Fraction to a	
A Decimal by 10 and by		Common Fraction.....	114
100	107	A Common Fraction to a	
Bills	108	Decimal Fraction.....	114
		REVIEW	117

CHAPTER IV: DENOMINATE NUMBERS..... 121-153

Measures of Capacity	121	Measures of Length, Area, and	
Liquid Measure.....	121	Volume	126
Dry Measure.....	121	Linear Measure.....	126
Measures of Weight and Value	122	Square Measure.....	126
Avoirdupois Weight.....	122	Cubic Measure.....	126
Troy Weight.....	123	Angular Measure	128
Apothecaries' Weight.....	123	Processes with Denominate	
United States Money.....	123	Numbers	130
Measures of Time	125	Reduction.....	130
Measuring by Twelves	125	Addition and Subtraction..	131
		Multiplication.....	132
		Division.....	133

CONTENTS

vii

	PAGES		PAGES
Applications of Denominate		Applications of Denominate	
Numbers.....	136	Numbers (<i>continued</i>)	
Measuring Surfaces.....	136	Finding the Difference	
Measuring Volume.....	144	between Dates.....	149
		REVIEW.....	151
 CHAPTER V: THE SOLUTION OF PROBLEMS.....	 154-169		
Unitary Analysis.....	156	The Use of Letters.....	163
Approximating Results.....	158	Number Pictures, or Graphs..	165
Ratio.....	160	REVIEW.....	168
 CHAPTER VI: DECIMAL FRACTIONS—PERCENTAGE..	 170-191		
Decimal Fractions.....	170	Percentage.....	178
Notation and Numeration	170	Meaning of Rate Per Cent.	178
Reduction of a Decimal		Finding a Percentage.....	180
Fraction to a Common		Finding How Many Per	
Fraction.....	171	Cent One Number Is of	
Reduction of a Common		Another.....	182
Fraction to a Decimal		Finding a Number from a	
Fraction.....	172	Given Percentage.....	184
Addition and Subtraction.	172		
Multiplication.....	174	REVIEW.....	186
Division.....	176		
 CHAPTER VII: BUSINESS APPLICATIONS.....	 192-214		
Gain and Loss.....	192	Banking.....	202
Commission.....	194	Savings Accounts.....	204
Trade Discount.....	196	Taxes and Duties.....	205
Interest.....	197	Insurance.....	207
Interest for a Fraction of a		Rates of Insurance.....	208
Year.....	201	REVIEW.....	212
 GENERAL REVIEW.....	 215-230		
TABLES.....	231, 232		
INDEX	233		

SECOND BOOK

REVIEW AND PREPARATION

NOTATION AND NUMERATION

ORAL EXERCISES

1. Name the ten figures commonly used in writing numbers.

2. Name the symbols used in writing numbers to 1000 by the Roman system.

3. How many places in each period in the common system of notation? Name the three places in units' period. Name the first three groups or periods.

4. How many of any place equal 1 of the next higher place?

5. In writing whole numbers, what is used to separate the periods?

6. In writing decimal numbers, what is used to show where the decimal begins?

Read:

- | | | | |
|-------------|----------------|----------|------------|
| 7. 425,026. | 10. 1,525.6. | 13. MCM. | 16. XLIX. |
| 8. 486.01. | 11. 1,630,200. | 14. DCV. | 17. XCV. |
| 9. 802,004. | 12. 9,990.95. | 15. CIV. | 18. MCMIX. |

WRITTEN EXERCISES

Write in figures :

1. Two hundred sixty-five thousand, one hundred twenty-five.
2. Five hundred twenty thousand, seventy-five.
3. Eight hundred one thousand, five hundred two.
4. Three million, five hundred thousand, nine.
5. Six hundred twenty-eight, and thirty-five hundredths.
6. Twenty-four hundred, and twenty-four hundredths.

Write in Roman notation :

- | | | | | |
|----------|-----------|-----------|-----------|-----------|
| 7. 76. | 10. 43. | 13. 17. | 16. 25. | 19. 1854. |
| 8. 1000. | 11. 500. | 14. 125. | 17. 100. | 20. 1265. |
| 9. 1908. | 12. 1776. | 15. 1910. | 18. 1620. | 21. 1492. |

ADDITION AND SUBTRACTION

TABLE 1

1	1	1	1	1	1	1	1	1
<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>

TABLE 2

2	2	2	2	2	2	2	2
<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>

1. State the sum in each case above; then write a similar table, using 3 as the top number. Similarly, write a table using 4 as the top number. Similarly, 5, 6, 7, 8, 9, as top numbers.

2. How many sums in Table 1? In Table 2? In each of the tables you have made? In the whole nine tables?

ORAL EXERCISES

1. Read the signs: +, -, =.
2. When several numbers are added into one sum, what is each number called?
3. In adding numbers of two or more figures, the sum of a column often exceeds ten. How do we proceed with the work in this case?
4. Since 8 and 9 are 17, seventeen is how many more than eight? Seventeen is how many more than nine?
5. In subtraction what is the number called from which we subtract? The number that we subtract?
6. Which is the larger number, the subtrahend or the minuend?
7. State a way of testing the work of subtraction.

Add rapidly:

1. 26	2. 92	3. 45	4. 4	5. 39	6. 50
35	29	32	30	49	96
24	10	26	98	59	23
17	49	19	76	46	44
<u>30</u>	<u>3</u>	<u>40</u>	<u>19</u>	<u>76</u>	<u>25</u>
7. \$46.33	8. \$146.25	9. \$99.36	10. 139.06		
<u>18.96</u>	<u>87.75</u>	<u>77.46</u>	<u>800.05</u>		

Subtract rapidly:

11. \$176.82	13. \$65.29	15. \$234.00	17. \$480.72
<u>77.46</u>	<u>46.33</u>	<u>146.25</u>	<u>166.99</u>
12. 145 in.	14. 86.5 yd.	16. 139.8 gal.	18. 184.5 mi.
<u>97 in.</u>	<u>17.9 yd.</u>	<u>98.9 gal.</u>	<u>67.8 mi.</u>

MULTIPLICATION**ORAL EXERCISES**

1. Read the sign \times . Read 3×4 in two ways.
2. What is the result of multiplication called? What are the numbers that form a product called?
3. Read the factors in each product:
 $3 \times 4 = 12.$ $8 \times 8 = 64.$ $2 \times 3 \times 5 = 30.$
4. There are 5 rows of 6 desks each. Would 6 rows of 5 desks each seat any more pupils? Any less? 45 ft.
5. In this problem which number is the multiplicand? The multiplier? The product?

$$\begin{array}{r} 23 \\ \times 6 \\ \hline 138 \end{array}$$
6. What is a short way of finding $36 + 36 + 36 + 36$?

$$\begin{array}{r} 90 \\ \times 4 \\ \hline 360 \end{array}$$
7. When the multiplier contains more than one figure, how are the partial products written?
8. How is the complete product found?

WRITTEN EXERCISES

1. The numbers in the top row of this table are the multiples of 2 from 1×2 to 12×2 . The numbers in the second row are multiples of what number?

2	4	6	8	10	12	14	16	18	20	22	24
3	6	9	12	15	18	21	24	27	30	33	36

2. Complete the table by writing the multiples of 4, 5, 6, and so on to 12.
3. Find the sum $45 + 45 + 45 + 45 + 45$ by multiplication.
4. How many hours in 7 full days?
5. How many days in 52 weeks?

Multiply:

6. 136 <u>8</u>	9. 205 <u>9</u>	12. 710 <u>7</u>	15. 2714 <u>15</u>	18. \$40.25 <u>8</u>
7. 813 <u>29</u>	10. 645 <u>43</u>	13. 708 <u>25</u>	16. 1802 <u>97</u>	19. \$56.33 <u>9</u>
8. 960 <u>40</u>	11. 876 <u>25</u>	14. 943 <u>77</u>	17. 1669 <u>97</u>	20. \$325.18 <u>68</u>

DIVISION**ORAL EXERCISES**

1. What does the sign \div mean?
2. Read the expression, $35 \div 7 = 5$.
3. In $56 \div 8 = 7$, which term is the dividend? The divisor? The quotient?
4. How does the product of the divisor and the quotient compare with the dividend?
5. In division we have the product and one factor given, and are asked to find the other factor. In $75 \div 3 = (?)$ which term is the product? Which is the one factor given? What is the other factor?
6. How many 8's are there in 72? How many times is 8 contained in 72?
7. How many 9's in 45? How many times is 9 contained in 45?
8. 24 is how many more than 8? 24 is how many times 8?
9. Similarly, compare 36 with 12 in two ways.
10. Compare 48 with 8 in two ways.
11. What is the test of the work in division?

WRITTEN EXERCISES

Divide:

1. $9\overline{)729}$

6. $8\overline{)728}$

11. $7\overline{)483}$

16. $6\overline{)336}$

2. $11\overline{)1210}$

7. $12\overline{)132}$

12. $12\overline{)4812}$

17. $15\overline{)2250}$

3. $7\overline{)48.30}$

8. $9\overline{)82.26}$

13. $15\overline{)90.15}$

18. $5\overline{)7.50}$

4. $13\overline{)270}$

9. $17\overline{)359}$

14. $21\overline{)463}$

19. $35\overline{)7065}$

5. $22\overline{)778}$

10. $36\overline{)4893}$

15. $25\overline{)1758}$

20. $48\overline{)9624}$

Find:

21. $\frac{1}{8}$ of 568. 23. $\frac{1}{12}$ of 1728. 25. $\frac{1}{15}$ of 2265. 27. $\frac{1}{11}$ of 14641.

22. $\frac{3}{5}$ of 4095. 24. $\frac{4}{15}$ of 3045. 26. $\frac{8}{25}$ of 625. 28. $\frac{7}{18}$ of 7236.

COMMON AND DECIMAL FRACTIONS

ORAL EXERCISES

1. What is a fraction? Name the numerator and the denominator in $\frac{5}{8}$.

2. What is an improper fraction? Name one.

3. What is a proper fraction? Name one.

4. Which is the larger: $\frac{1}{2}$ or $\frac{1}{3}$? $\frac{2}{3}$ or $\frac{3}{4}$? $\frac{1}{4}$ or $\frac{1}{5}$? $\frac{2}{3}$ or $\frac{1}{2}$? $\frac{3}{4}$ or $\frac{5}{8}$?

5. $\frac{3}{8}$ is how many fourths? $\frac{4}{15}$ is how many thirds?

6. How is a fraction reduced to lower terms?

7. By what must both numerator and denominator of $\frac{3}{4}$ be multiplied to make $\frac{9}{12}$?

8. Change $\frac{3}{8}$ to an equal fraction whose denominator is 6.

9. How must fractions be expressed before they can be added or subtracted?

10. In decimal fractions what is the first place at the right of the decimal point? What is the second place?

WRITTEN EXERCISES*Add:*

1. $\frac{1}{8} + \frac{3}{4}$.

3. $\frac{4}{5} + \frac{2}{3}$.

5. $\frac{2}{5} + \frac{1}{2}$.

7. $\frac{3}{4} + \frac{5}{6}$.

2. $\frac{2}{8} + \frac{5}{6}$.

4. $\frac{3}{4} + \frac{2}{3}$.

6. $\frac{5}{6} + \frac{1}{2}$.

8. $\frac{3}{5} + \frac{1}{3}$.

Subtract:

9. $\frac{5}{6} - \frac{1}{2}$.

11. $\frac{5}{6} - \frac{3}{8}$.

13. $\frac{4}{5} - \frac{1}{2}$.

15. $\frac{3}{4} - \frac{3}{8}$.

10. $\frac{2}{5} - \frac{1}{6}$.

12. $\frac{3}{4} - \frac{2}{3}$.

14. $\frac{7}{8} - \frac{3}{4}$.

16. $\frac{5}{6} - \frac{4}{5}$.

Solve:

17. $\frac{1}{2}$ day and $\frac{1}{4}$ day are what part of a day?

18. $\frac{2}{3}$ hr. and $\frac{1}{3}$ hr. are what part of an hour?

19. A man owned $\frac{1}{2}$ of a factory and purchased $\frac{1}{4}$ more. What fraction did he then own?

20. A man owned $\frac{3}{4}$ of a factory and sold an amount equal to $\frac{1}{4}$ of the whole factory. What part of the property did he still own?

21. A man's will divided $\frac{2}{3}$ of his property equally among 4 heirs. What part of the whole property did each receive?

Multiply:

22. $\frac{2}{3}$ by 3.

25. $6 \times \frac{9}{10}$.

28. $\frac{7}{8} \times 3$.

31. 6 by $\frac{2}{3}$.

23. $\frac{3}{4}$ by 9.

26. 2 by $\frac{5}{6}$.

29. $\frac{3}{7} \times 4$.

32. $\frac{6}{7} \times 3$.

24. $3 \times \frac{1}{2}$.

27. 8 by $\frac{8}{9}$.

30. 8 by $\frac{4}{5}$.

33. $5 \times \frac{3}{5}$.

34. One-half of two-thirds of a day is how many hours?

35. How many are two-thirds of five-sixths of 36?

Divide:

36. $\frac{4}{5} \div 4$.

38. $\frac{9}{10} \div 3$.

40. $\frac{8}{9} \div 4$.

42. $\frac{2}{3} \div 3$.

37. $\frac{7}{8} \div 2$.

39. $\frac{5}{6} \div 4$.

41. $\frac{14}{15} \div 7$.

43. $\frac{10}{11} \div 5$.

Add :

$$\begin{array}{r} 44. \text{ 8.65} \\ 7.32 \\ \hline \end{array}$$

$$\begin{array}{r} 45. \text{ 409.6} \\ 178.9 \\ \hline \end{array}$$

$$\begin{array}{r} 46. \text{ 110.46} \\ 49.73 \\ \hline \end{array}$$

$$\begin{array}{r} 47. \text{ 84.51} \\ 47.09 \\ \hline \end{array}$$

Subtract :

$$\begin{array}{r} 48. \text{ 99.8} \\ 65.7 \\ \hline \end{array}$$

$$\begin{array}{r} 49. \text{ 40.73} \\ 9.88 \\ \hline \end{array}$$

$$\begin{array}{r} 50. \text{ 176.1} \\ 48.7 \\ \hline \end{array}$$

$$\begin{array}{r} 51. \text{ 100.01} \\ 98.76 \\ \hline \end{array}$$

Multiply :

$$\begin{array}{r} 52. \text{ 3.6} \\ 45 \\ \hline \end{array}$$

$$\begin{array}{r} 53. \text{ 1.26} \\ 34 \\ \hline \end{array}$$

$$\begin{array}{r} 54. \text{ 4.58} \\ 96 \\ \hline \end{array}$$

$$\begin{array}{r} 55. \text{ 7.03} \\ 89 \\ \hline \end{array}$$

Divide :

$$56. \text{ 15} \overline{)2.25}$$

$$57. \text{ 23} \overline{)4.60}$$

$$58. \text{ 12} \overline{)49.2}$$

$$59. \text{ 9} \overline{)85.59}$$

60. State the decimal form for each:

$$\frac{1}{2}$$

$$\frac{1}{4}$$

$$\frac{2}{4}$$

$$\frac{3}{4}$$

$$\frac{1}{5}$$

$$\frac{3}{5}$$

$$\frac{4}{5}$$

$$\frac{2}{5}$$

Solve :

61. The distance from city A to city B is 135.5 mi. and from city B to city C is 79.9 mi. How many miles is it from A to C by way of B?

62. A farmer bought 40.15 acres of land and sold 29.65 acres. How many acres had he left?

63. A square is 14.3 yd. on a side. How many yards is it around the square?

DENOMINATE NUMBERS

ORAL EXERCISES

1. The foot is a *unit of measure* for finding length. Name two other units of measure for finding length.

2. Name two units of measure for measuring liquid.

3. Name two units of area for measuring surfaces.

4. Name three units for measuring grains and vegetables.
5. Name two units for measuring volume.
6. Name four units for measuring time.
7. Name three units for measuring weight.
8. Name five coins for measuring value.

WRITTEN EXERCISES

Copy, supplying the missing numbers :

- | | |
|-------------------------------------|------------------------------|
| 1. () in. = 1 ft. | 5. () pt. = 1 qt. |
| () ft. = 1 yd. | () qt. = 1 gal. |
| () ft. = 1 rd. | () pt. = 1 gal. |
| () in. = 1 yd. | () pt. = $\frac{3}{4}$ gal. |
| 2. () qt. = 1 pk. | 6. () cts. = 1 dime. |
| () pk. = 1 bu. | () dimes = 1 dollar. |
| () qt. = 1 bu. | () cts. = 1 dollar. |
| () qt. = $\frac{1}{2}$ bu. | () 5-cent pieces = \$1. |
| 3. () sq. in. = 1 sq. ft. | 7. () oz. = 1 lb. |
| () sq. ft. = 1 sq. yd. | () oz. = $\frac{1}{4}$ lb. |
| () sq. rd. = 1 acre. | () lb. = 1 T. |
| 4. () cu. in. = 1 cu. ft. | 8. () hr. = 1 da. |
| () cu. ft. = 1 cu. yd. | () da. = 1 wk. |
| () cu. ft. = $\frac{2}{3}$ cu. yd. | () min. = 1 hr. |

Add :

- | | | |
|---|---|---|
| 9. $\begin{array}{r} 10 \text{ ft. } 9 \text{ in.} \\ \underline{8 \text{ ft. } 11 \text{ in.}} \end{array}$ | 11. $\begin{array}{r} 7 \text{ gal. } 3 \text{ qt.} \\ \underline{4 \text{ gal. } 2 \text{ qt.}} \end{array}$ | 13. $\begin{array}{r} 8 \text{ bu. } 3 \text{ pk.} \\ \underline{7 \text{ bu. } 3 \text{ pk.}} \end{array}$ |
| 10. $\begin{array}{r} 7 \text{ rd. } 15 \text{ ft.} \\ \underline{5 \text{ rd. } 10 \text{ ft.}} \end{array}$ | 12. $\begin{array}{r} 20 \text{ min. } 18 \text{ sec.} \\ \underline{17 \text{ min. } 50 \text{ sec.}} \end{array}$ | 14. $\begin{array}{r} 12 \text{ wk. } 5 \text{ da.} \\ \underline{37 \text{ wk. } 6 \text{ da.}} \end{array}$ |

Subtract :

- | | | |
|---|---|---|
| 15. $\begin{array}{r} 40 \text{ lb. } 12 \text{ oz.} \\ \underline{17 \text{ lb. } 10 \text{ oz.}} \end{array}$ | 16. $\begin{array}{r} 7 \text{ gal. } 2 \text{ qt.} \\ \underline{4 \text{ gal. } 3 \text{ qt.}} \end{array}$ | 17. $\begin{array}{r} 37 \text{ wk. } 2 \text{ da.} \\ \underline{12 \text{ wk. } 5 \text{ da.}} \end{array}$ |
|---|---|---|

BUSINESS ARITHMETIC

1. What is a bill? A price list?
2. Find the value of each item and the total of this bill:

Sacks and Co.
Importers and Retailers,
San Francisco, Cal.

2/27/1909.

Sold to John Smith
620 Market St.

5 yd. lace	@ \$.45 a yd.				
15 handker'fs	@ .25 each				
8 yd. muslin	@ .16 a yd.				
12 yd. silk	@ .90 a yd.				

3. At 25 cts. per yard, how many yards can be bought for a dollar?
4. What part of a dollar is: 25¢? 50¢? 20¢? 40¢? 75¢?
5. When 40 bu. of potatoes cost \$30, what will 17 bu. cost at the same rate?

PROBLEMS

1. The usual weight of a bale of hops is 200 lb. How many bales are there in 1 ton? In a car-load of 10 tons?
2. 2,000 roots are required to plant an acre of hops. How many are required to plant 25 acres? What is the cost of planting 25 acres at \$1 per 1000 plants?
3. The wire trellis to support the vines costs \$75 an acre. What is the cost for 25 acres?

4. Picking the hops costs at the rate of 1 ct. a pound, and $3\frac{1}{2}$ lb. of green hops make 1 lb. of dry hops. What is the cost of picking enough to make 1 ton of dry hops?

5. One cord of willow wood costing \$5 will dry 1000 lb. of hops. What is the cost of wood enough to dry 100 bales of 200 lb. each?

6. A common kit of manual-training tools costs about \$6. How much does it cost to supply 25 boys with these tools?

7. A garden in the form of a rectangle 30 yd. wide and 40 yd. long is to be represented on the blackboard. Name a convenient length to represent 1 yd.

8. What is the distance around the garden mentioned in Exercise 7? What is the distance around the drawing?

9. If an inch in a drawing represents 40 ft., how many feet does $\frac{1}{4}$ of an inch represent? $\frac{1}{8}$ of an inch? How many do 3 inches represent? $3\frac{1}{2}$ inches?

10. In such a drawing what length represents 20 feet? 10 ft.? 30 ft.? 60 ft.? 75 ft.?

11. How many hours are there in a week?

12. How many minutes are there in a working day of 8 hr.?

13. 4 min. are how many seconds? Are what part of an hour?

14. 3 months and 15 days are what part of a year?

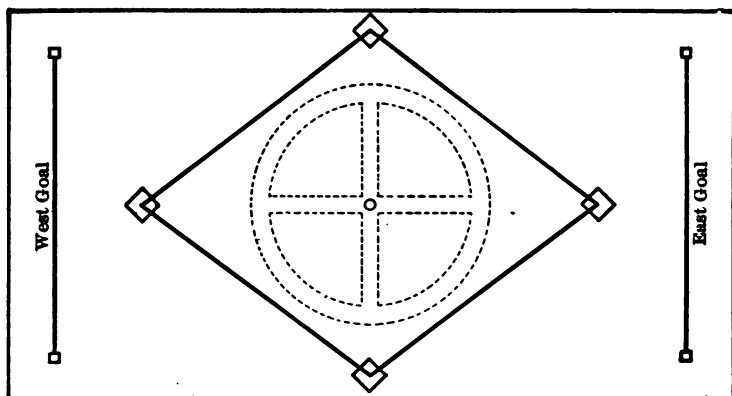
15. At 20 cts. a dozen for buttons, how much must I pay for a gross?

16. A case of 300 oranges brought 45 cts. a dozen. What were the oranges worth?

17. Into how many compartments, 1 ft. square, could I divide a box 8 ft. long and 6 ft. wide?

18. 8 pk. 6 qt. of berries will fill how many pint baskets?

19. A farm of 120 acres was worth \$2 a sq. rd. How much was the farm worth?



20. In this drawing of a playground 1 inch represents 20 ft. Find the length of each side. What is the distance around the playground?

21. What is the length of each goal? What is the distance between the goals? How far are they from the ends of the playground? Measure other distances.

22. What is the area of the playground?

23. If your school has a playground, estimate or measure its length and breadth. Select a convenient scale and make a drawing of the playground.

24. Estimate or measure the length and breadth of the school-room. Make to scale a drawing of the room.

25. Find the size and position of each of the desks and locate them in your drawing. Do the same for windows and doors.

26. In your village or city what is the length of a block? How many blocks are there to the mile?

27. What is the cost of 108 stamped envelopes at 26 cts. a dozen?

28. What is the cost of 25 two-cent stamps, 2 dozen stamped envelopes bearing 2-cent postage (Exc. 27), and 50 postal cards?

29. If a postman has in his sack 200 pieces of mail averaging 2 oz. in weight, what is the weight of the mail?

30. A certain post-office has 4 mail-carriers, and each carrier has a route with 1000 addresses. If each carrier delivers 1 piece for every 5 addresses, how many pieces does each distribute at one delivery? How many pieces do the 4 carriers distribute?

31. There are two deliveries a day. How many pieces of mail are delivered in all per day?

32. If the postage averages 2 cts. per piece, how many dollars' worth of stamps are canceled on 3,200 pieces?

33. 15 money-orders were sold, for which the post-office received \$2.25; also 480 stamped envelopes at 26 cts. a dozen; 300 single postal cards, and 200 with return card attached. How much did the office receive from these sources?

34. The four carriers are paid at the rate of \$2 a day each, the postmaster at the rate of \$5, and 2 clerks at the rate of \$1.75 each. What does the labor in this post-office cost the Government per month of 30 days?

35. There are 120 lock-boxes in a post-office, $\frac{1}{4}$ of which are rented at 25 cts. a month each. What is the income from these boxes in a year?

36. Make and solve 3 problems, using the data of the table:

SALARIES PER YEAR.		RECEIPTS.	
Postmaster	\$2,000	Stamps.....	\$5,000
Assistant.....	1,500	Money-orders.....	500
2 clerks.....each at	800	Cards.....	400
4 carriers.....each at	725	400 boxes.....each at	2

37. Make problems about the postal service in your city.

38. How much did the farmer receive who sold these crops: Hay, \$75; wheat, \$50.75; corn, \$100; oats, \$96.50; cabbage, \$136.42; apples, \$236.25?

39. The following are the ingredients of a fertilizer for vineyards: phosphate, ground bone, and potash in equal amounts. If an acre requires 900 lb. of fertilizer, how many pounds of each ingredient are used on an acre?

40. How many tons of such fertilizer are needed for a 5-acre vineyard?

41. A fertilizer for growing strawberries consists of 1 part nitrate of soda, 2 parts phosphate, 2 parts ground bone, and 2 parts potash. Thus, $\frac{1}{4}$ is nitrate of soda, $\frac{2}{4}$ is phosphate, and so on. How many pounds of each ingredient are there in 700 lb. of fertilizer?

42. $1\frac{1}{4}$ tons of fertilizer will fertilize 5 acres of strawberries. How many pounds are used per acre?

43. If a cow gives 450 lb. of milk in a month and each 100 lb. contains 4 lb. of fat, how much fat is there in the month's product? What part of the milk is fat?

44. According to Exercise 43, how many pounds of milk would a dairy of 20 cows produce in a month? If $\frac{1}{4}$ of this amount remains after removing the cream, what is the weight of the month's product of cream?

45. A car loaded with coal weighs about 60,000 lb. How many tons does such a car with its load weigh?

46. A large battleship weighs 20,000 tons. How many carloads of coal like the one mentioned in Exercise 45 would weigh as much as a large battleship?

47. A cubic foot of water weighs 1000 oz. How many pounds in this?

48. A tank 10 ft. long, 3 ft. wide, and 2 ft. deep is filled with water. According to Exercise 47, what is the weight of the water in the tank?

49. Similarly, what is the weight of the water in a tank 25 ft. long, 16 ft. wide, and 10 ft. deep when half full of water?

CHAPTER I

PROCESSES WITH INTEGERS

NOTATION AND NUMERATION

1. Whole numbers are called **integers**. Integers are expressed by places and periods as follows:

- | | | |
|----------------------|------|---------------------|
| 1. Ten units | make | one ten. |
| 2. Ten tens | make | one hundred. |
| 3. Ten hundreds | make | one thousand. |
| 4. Ten thousands | make | 1 ten-thousand. |
| 5. Ten ten-thousands | make | 1 hundred-thousand. |

2. Similarly, 10 hundred-thousands are grouped to make 1 **million**; 10 millions are grouped into 1 **ten-million**; and 10 **ten-millions** are grouped into 1 **hundred-million**.

<div style="display: flex; flex-direction: column; align-items: center;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">HUNDRED-MILLIONS</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">TEN-MILLIONS</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">MILLIONS</div> </div>	,	<div style="display: flex; flex-direction: column; align-items: center;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">HUNDRED-THOUSANDS</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">TEN-THOUSANDS</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">THOUSANDS</div> </div>	,	<div style="display: flex; flex-direction: column; align-items: center;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">HUNDREDS</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">TENS</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">UNITS</div> </div>
6		3		5
7		2		3
5		1		6
<hr style="width: 100%;"/>		<hr style="width: 100%;"/>		<hr style="width: 100%;"/>
<i>Periods :</i> Millions		Thousands		Units

The table above shows the names of the first nine places or **orders** and the first three **periods**.

The period at the left in a number may not be complete. It may contain only one or two figures, as in 6,218 or in 65,421,233. How many must the other periods contain? Read the number in the table.

3. Each period, beginning at the left, is read as if it were a number by itself, the name of the period being added except in the case of units' period, for which it is understood.

ORAL EXERCISES

Read :

- | | | |
|---------------|---------------|---------------|
| 1. 4,000,000. | 3. 4,100,000. | 5. 7,326,000. |
| 2. 9,001,430. | 4. 8,600,020. | 6. 8,625,365. |

7. Read, from the table below, the numbers of people speaking various languages in each century:

PEOPLE.	19TH CENTURY.	20TH CENTURY.
English.....	20,520,000	111,100,000
French.....	31,450,000	51,200,000
German.....	30,320,000	75,200,000
Italian.....	15,070,000	33,400,000
Spanish.....	26,190,000	42,800,000
Russian.....	30,770,000	75,000,000.

WRITTEN EXERCISES

Write in figures :

- Eight millions.
- Eighty-five millions.
- Four million two hundred seventy-five thousand.
- Sixty-two million, three hundred eight thousand, two hundred seventy-nine.
- Five million, six hundred ninety-eight thousand, ten.
- Two million, thirty-one thousand, one hundred seven.
- Twenty million, four hundred thousand, two.

ADDITION

4. Counting two or more numbers into a single number is called **addition**. The sign of addition is **+**.

The numbers added are called **addends**.

The result is called the **sum**.

5. In adding pairs of two-figure numbers it is shorter to add the tens of one addend to the whole of the other.

$$\begin{array}{r} 76 \\ 25 \\ \hline 101 \end{array}$$

Thus, in adding 25 and 76, we think "76 plus 20 are 96, and 5 are 101."

ORAL EXERCISES

Add the following as indicated above:

1. 46 35 <hr/>	3. 46 71 <hr/>	5. 86 45 <hr/>	7. 40 61 <hr/>	9. 48 90 <hr/>	11. 98 89 <hr/>
2. 93 28 <hr/>	4. 36 53 <hr/>	6. 39 94 <hr/>	8. 57 75 <hr/>	10. 29 32 <hr/>	12. 96 84 <hr/>

6. When the addends are small two-figure numbers and one-figure numbers, add both columns at once.

Thus, in Exercise 1 below, think "21, 28, 33, 44," and so on.

ORAL EXERCISES

Add rapidly upward; then add downward:

1. 9 10 6 11 5 7 21 <hr/>	2. 12 5 10 7 6 11 15 <hr/>	3. 10 11 8 9 12 5 13 <hr/>	4. 13 9 7 12 10 4 9 <hr/>	5. 22 8 11 1 7 10 9 <hr/>
--	---	---	--	--

6. 20	7. 30	8. 5	9. 15	10. 50
10	10	11	19	8
11	16	5	11	2
7	6	4	31	1
6	4	6	7	9
5	9	11	5	9
10	7	10	10	11
<u>8</u>	<u>8</u>	<u>30</u>	<u>23</u>	<u>8</u>

Add, grouping by 10 where possible:

Thus, in Exercise 11, think "6 and 10, or 16; 16 and 10, or 26; 36; 40; 50; 57."

11. 7	13. 8	15. 9	17. 8	19. 6
8 } 2 }	9	9	3	3
4	7	2	8	3
5 } 5 }	3	4	5	3
7 }	2	6	7	3
3 }	8	5	7	1
8 }	6	3	1	1
2 }	1	7	9	1
6	9	8	4	5
	8	2	6	5
	7	9	5	5
<u>6</u>	<u>7</u>	<u>9</u>	<u>5</u>	<u>5</u>

12. 1	14. 4	16. 8	18. 4	20. 7
9	6	2	6	1
7	5	4	3	2
3	5	4	1	3
8	2	2	6	4
2	3	7	2	3
5	5	3	7	5
3	8	9	1	4
<u>7</u>	<u>2</u>	<u>1</u>	<u>5</u>	<u>1</u>

WRITTEN EXERCISES

	AREA IN SQ. MI.	POPULA- TION.		AREA IN SQ. MI.	POPULA- TION.
Alabama.....	52,250	2,250,000	New H'pshire ..	9,305	443,700
Alaska.....	590,884	125,000	New Jersey	7,815	2,294,412
Arizona.....	113,020	185,000	New Mexico ...	122,580	302,000
Arkansas.....	53,850	1,750,000	New York.....	49,170	8,476,427
California.....	158,360	2,000,000	N. Carolina....	52,250	2,100,000
Colorado.....	103,925	800,000	N. Dakota.....	70,795	475,000
Connecticut....	4,990	1,010,000	Ohio	41,060	4,557,000
Delaware.....	2,050	190,000	Oklahoma.....	70,430	1,408,732
Dist. of Col....	70	330,000	Oregon.....	96,030	550,000
Florida.....	58,680	650,000	Pennsylvania ..	45,215	6,900,000
Georgia.....	59,475	2,600,000	Rhode Island..	1,250	502,302
Hawaii.....	6,449	154,001	S. Carolina....	30,570	1,474,735
Idaho.....	84,800	300,000	S. Dakota.....	77,650	490,000
Illinois.....	56,650	5,590,000	Tennessee.....	42,050	2,220,000
Indiana.....	36,850	2,678,492	Texas.....	265,780	3,600,000
Iowa.....	56,025	2,216,068	Utah.....	84,970	350,000
Kansas.....	82,080	1,680,000	Vermont	9,565	340,000
Kentucky.....	40,400	2,435,000	Virginia.....	42,450	2,042,388
Louisiana.....	48,720	1,700,000	Washington....	69,180	900,000
Maine.....	33,040	731,760	W. Virginia....	24,780	1,200,000
Maryland.....	12,210	1,441,602	Wisconsin.....	56,040	2,275,000
Massachusetts..	8,315	3,173,487	Wyoming.....	97,890	117,500
Michigan.....	58,915	2,655,463			
Minnesota.....	83,365	2,200,000	ISLANDS.		
Mississippi.....	46,810	1,750,000	G u a m (L a -		
Missouri.....	69,415	3,885,989	drones).....	150	8,661
Montana.....	146,080	275,000	Philippine Is..	140,000	7,635,426
Nebraska.....	77,510	1,225,000	Porto Rico.....	3,600	953,243
Nevada.....	110,700	65,000	Samoan Is.....	79	5,800

1. The estimated population of the United States, excluding the islands, is 89,066,059. What is the total *including* them?

Find from the table the total area and population of the states bordering on:

2. The Atlantic Ocean.
3. The Gulf of Mexico.
4. The Great Lakes.
5. The Pacific Ocean.
6. The Mississippi River.
7. Your own State.

7. \$4 and \$7 are like numbers, because they are made up of the same *units*, dollars; similarly 3 qt. and 5 qt. are like numbers; but 3 qt. and 1 pt. are unlike numbers.

In order to add 4 gal. and 3 qt., how must 4 gal. be expressed?

\$96.50
84.30
106.35
99.67
208.95
706.52
500.08

8. Only like numbers can be added or subtracted.

Hence, in writing for addition numbers expressing dollars and cents, they should be so arranged that the decimal points stand in a column; cents then fall in columns with cents, and dollars with dollars.

27
3 1
39
26
15

9. In adding several long columns, write the sum of each column separately and add the partial sums, as in the example at the right.

\$1802.37

WRITTEN EXERCISES

Add:

The correct results of these four problems should be obtained in 3 minutes or less.

1. \$145.35	2. \$108.16	3. \$208.25	4. \$463.20
86.25	94.15	196.40	892.17
90.07	83.95	307.65	101.05
120.33	204.76	99.77	40.15
45.10	607.25	44.96	69.90
<u>17.98</u>	<u>594.33</u>	<u>863.52</u>	<u>128.77</u>

SUBTRACTION

10. Finding how much one number exceeds another is called **subtraction**. The sign of subtraction is —.

The result of subtraction is called the **difference** or **remainder**.

In subtraction the larger number is called the **minuend**, and the smaller the **subtrahend**.

11. Subtraction is most rapidly done by thinking what number added to the smaller number will make the larger.

563 Thus, in the problem at the left, we think "8 and 5 are
198 13" and write 5; "9 and 6 are 15" and write 6; "1
365 and 3 are 4" and write 3.

Test: $198 + 365 = 563$.

ORAL EXERCISES

Subtract rapidly:

- | | | | | |
|---|---|---|---|---|
| 1. $\begin{array}{r} 89 \\ 46 \\ \hline \end{array}$ | 3. $\begin{array}{r} 87 \\ 29 \\ \hline \end{array}$ | 5. $\begin{array}{r} 409 \\ 161 \\ \hline \end{array}$ | 7. $\begin{array}{r} 969 \\ 492 \\ \hline \end{array}$ | 9. $\begin{array}{r} 765 \\ 291 \\ \hline \end{array}$ |
| 2. $\begin{array}{r} 63 \\ 36 \\ \hline \end{array}$ | 4. $\begin{array}{r} 45 \\ 19 \\ \hline \end{array}$ | 6. $\begin{array}{r} 980 \\ 39 \\ \hline \end{array}$ | 8. $\begin{array}{r} 738 \\ 370 \\ \hline \end{array}$ | 10. $\begin{array}{r} 464 \\ 252 \\ \hline \end{array}$ |
| 11. $\begin{array}{r} 80 \text{ in.} \\ 26 \text{ in.} \\ \hline \end{array}$ | 14. $\begin{array}{r} 59 \text{ ft.} \\ 32 \text{ ft.} \\ \hline \end{array}$ | 17. $\begin{array}{r} 65 \text{ lb.} \\ 46 \text{ lb.} \\ \hline \end{array}$ | 20. $\begin{array}{r} 40 \text{ da.} \\ 26 \text{ da.} \\ \hline \end{array}$ | |
| 12. $\begin{array}{r} \$7.63 \\ 2.48 \\ \hline \end{array}$ | 15. $\begin{array}{r} \$8.25 \\ 3.65 \\ \hline \end{array}$ | 18. $\begin{array}{r} \$1.93 \\ .76 \\ \hline \end{array}$ | 21. $\begin{array}{r} \$2.45 \\ .75 \\ \hline \end{array}$ | |
| 13. $\begin{array}{r} \$10.05 \\ 3.05 \\ \hline \end{array}$ | 16. $\begin{array}{r} \$12.20 \\ 8.40 \\ \hline \end{array}$ | 19. $\begin{array}{r} \$19.75 \\ 6.95 \\ \hline \end{array}$ | 22. $\begin{array}{r} \$25.36 \\ 15.98 \\ \hline \end{array}$ | |

WRITTEN EXERCISES

Subtract:

Find how many of these you can solve correctly in 5 minutes.

- | | | | |
|--|--|--|--|
| 1. $\begin{array}{r} \$463.20 \\ 188.29 \\ \hline \end{array}$ | 3. $\begin{array}{r} \$635.89 \\ 263.74 \\ \hline \end{array}$ | 5. $\begin{array}{r} 89735 \\ 28679 \\ \hline \end{array}$ | 7. $\begin{array}{r} 46893 \\ 25635 \\ \hline \end{array}$ |
| 2. $\begin{array}{r} \$523.42 \\ 263.98 \\ \hline \end{array}$ | 4. $\begin{array}{r} \$998.65 \\ 325.87 \\ \hline \end{array}$ | 6. $\begin{array}{r} 32577 \\ 8929 \\ \hline \end{array}$ | 8. $\begin{array}{r} 73548 \\ 34767 \\ \hline \end{array}$ |

9. \$673.19 <u>87.64</u>	11. \$727.65 <u>423.84</u>	13. 46969 <u>15797</u>	15. 85927 <u>9876</u>
10. \$325.50 <u>169.75</u>	12. \$827.88 <u>525.97</u>	14. 798354 <u>259899</u>	16. 72555 <u>34969</u>

Solve:

17. The cost of a city dwelling and site was \$500,000; the site cost \$175,500. What was the cost of the building alone?

18. In building a street the cost of grading and paving was \$159,650; of grading alone, \$45,650. What did the paving cost?

19. The elementary schools of a certain city had 45,268 pupils, of which 19,829 were in the Primary schools. How many were in the Grammar schools?

20. The area of New York State is 49,170 sq. mi., and that of Texas 265,780 sq. mi. Find the difference in their areas.

21. Alaska contains 590,884 sq. mi., and Texas 265,780 sq. mi. Alaska is how many square miles larger than Texas?

MAKING CHANGE

12. In making change we add to the amount of the purchase enough to equal the amount of money offered in payment.

Thus, a customer bought a book for \$1.20 and offered a two-dollar bill. The clerk said, as he gave the customer a 5-cent piece, a quarter, and a 50-cent piece, "One twenty-five, fifty, two dollars."

ORAL EXERCISES

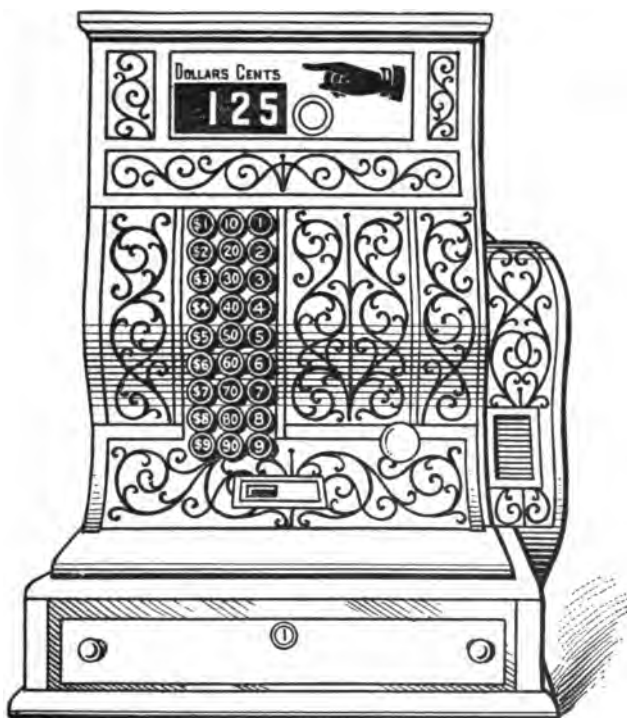
What change was given in each of the following cases?

PURCHASE	AMT. REC'D	PURCHASE	AMT. REC'D
1. \$2.25	\$5.00	4. \$.58	\$1.00
2. 1.98	5.00	5. .63	2.00
3. .97	2.00	6. .38	1.00

MAKING CHANGE

23

PURCHASE	AMT. REC'D	PURCHASE	AMT. REC'D
7. \$2.45	\$4.00	13. \$1.37	\$5.00
8. 3.75	5.00	14. 2.48	3.00
9. 4.80	5.00	15. 3.70	4.00
10. 5.75	10.00	16. 8.90	10.00
11. 7.68	10.00	17. 9.01	10.00
12. .63	2.00	18. 10.05	12.00



The picture shows a cash register. To record a purchase of \$1.25, the clerk presses the key marked \$1, then the key marked 20 in the next column, and the key marked 5 in the last column at the right. The machine prints this amount on a slip of paper within.

ORAL EXERCISES

Read the amount of money shown by the cash register when each of the following sets of keys is pressed:

	DOLLARS	CENTS	CENTS		DOLLARS	CENTS	CENTS
1.	1	30	5	4.	1	20	9
2.	2	50	5	5.	2		5
3.	3	10	6	6.	3	20	

WRITTEN EXERCISES

1. Write the numbers in the Oral Exercises above, using the dollar sign and the decimal point.

What keys would indicate:

2. Two dollars and thirty-five cents?

3. Three dollars and twenty-three cents?

4. Five dollars and seventy-five cents?

5. \$1.18?

6. \$3.29?

7. \$9.99?

8. \$8.53?

9. If no key is pressed in the dollar column, this part of the register shows 0 dollars; similarly, zeros register no dimes and cents. What keys are pressed to indicate \$0.17, or \$.17? \$.75? \$1.05? \$2.20? \$.08?

What would be the total amount registered:

10. By pressing the 1-dollar key twice and the 5-dime key 5 times?

11. By pressing the 3-dollar key once, the 1-dime key twice, and the 5-cent key once?

12. By pressing the 7-dollar key six times, the 4-dime key three times and the 8-cent key five times?

13. What amount would be registered by pressing all of the keys in the right hand column?

14. What amount would be registered by pressing all of the keys in the three columns?

MULTIPLICATION

- 13.** The process of taking one number as many times as an addend as there are units in another is called **multiplication**.
- Thus, in the example at the left, 3 times 36 means $36 + 36 + 36$, or 36 taken 3 times as an addend.
- $$\begin{array}{r} 36 \\ 36 \\ 36 \\ \hline 108 \end{array} \left\{ \begin{array}{l} 36 \\ 3 \\ 108 \end{array} \right.$$

The number multiplied is called the **multiplicand**.

The number by which the multiplicand is multiplied is called the **multiplier**.

The result of multiplication is called the **product**.

$$\begin{array}{r} 85 \text{ Multiplicand} \\ 12 \text{ Multiplier} \\ \hline 170 \\ 85 \\ \hline 1020 \text{ Product.} \end{array}$$

- 14.** The multiplier and multiplicand are **factors** of the product.

- 15.** The sign \times is read "times" or "multiplied by."
Thus, 4×6 is read "4 times 6" or "4 multiplied by 6."

ORAL EXERCISES

Read, and supply the results in each line:

(Thus, the first line begins "2 times 2 are 4, 2 times 3 are 6.")

1.	$2 \times$	2	3	5	4	7	6	9	8	1	10	12	11

2.	$3 \times$	2	3	5	4	7	6	9	8	1	10	12	11

3.	$4 \times$	2	3	5	4	7	6	9	8	1	10	12	11

4.	$5 \times$	2	3	5	4	7	6	9	8	1	10	12	11

16. 2, 4, 6, 8, are called **multiples** of 2. 3, 6, 9, 12, are called multiples of 3, and so on.

ORAL EXERCISES

1. Name the multiples of 3 from 3 to 36.
2. Name the multiples of 4 from 4 to 48.
3. Name the multiples of 5 from 5 to 60.
4. Name the multiples of 10 from 10 to 120.

WRITTEN EXERCISES

1-7. Write tables similar to those on page 25, using 6, 7, 8, 9, 10, 11, 12 as the numbers at the left.

17. Numbers that relate to particular objects or measures are called **concrete numbers**. Those that do not are called **abstract numbers**.

Thus, \$46, 8 cts., 2 books, 1.5 ft. are concrete numbers, while 46, 8, 2, 1.5 are abstract numbers.

18. *The multiplier must be an abstract number.*

19. *The product is of the same kind as the multiplicand.*

20. EXAMPLE: What is the cost of 8 yd. of muslin at 12 cts. per yard?

Solution: $8 \times 12\phi = 96\phi$.

The multiplier is 8, not 8 yd. It would be meaningless to say 8 yd. times 12 cts. The product is *cents* because the multiplicand is *cents*.

WRITTEN EXERCISES

Multiply:

Find how many problems you can do correctly in five minutes.

- | | | | | |
|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| 1. 645 | 2. 763 | 3. 496 | 4. 290 | 5. 975 |
| 18 | 29 | 87 | 15 | 49 |
| <hr style="width: 50px; margin: 0;"/> | <hr style="width: 50px; margin: 0;"/> | <hr style="width: 50px; margin: 0;"/> | <hr style="width: 50px; margin: 0;"/> | <hr style="width: 50px; margin: 0;"/> |

6. 863 <u>247</u>	7. 1296 <u>834</u>	8. 4089 <u>735</u>	9. 5201 <u>910</u>	10. 4631 <u>208</u>
----------------------	-----------------------	-----------------------	-----------------------	------------------------

11. 908×476 . 12. 826×542 . 13. 6309×569 .

Solve:

14. How many tons of coal in 123 car loads of 45 tons each?
15. How many yards of wire in 215 rolls of 125 yd. each?
16. How many miles will an automobile travel in 26 days, if it runs 165 mi. a day?
17. A wall was built of 672 blocks of stone, each weighing 985 lb. What was the weight of the wall?

Multiplication by 10 and by 100

21. If any integer is multiplied by 10, the result is called a multiple of 10. What is the figure at the right in a multiple of 10?

22. *Any integer is multiplied by 10 by adding a zero at the right.*

1. To multiply by 20 is to multiply by 2 and annex how many zeros?

2. To multiply by 30 is to multiply by 3 and annex how many zeros?

23. Name some multiples of 100. Multiples of 100 have what two figures at the right?

24. *Any integer is multiplied by 100 by adding two zeros at the right.*

1. To multiply by 200 is to multiply by 2 and annex how many zeros?

2. To multiply by 300 is to multiply by 3 and annex how many zeros?

ORAL EXERCISES

1. Multiply by 10: 7; 8; 10; 9; 15; 12; 25.
2. State how to multiply any integer by 30. By 40. By 60. By 90. By 100.
3. Multiply by 100: 8; 5; 6; 10; 15; 40; 25.
4. State how to multiply any integer by 300. By 400. By 700. By 900. By 500.

WRITTEN EXERCISES

1. Multiply the following by 20: 17; 15; 9; 12; 48.
2. Multiply the following by 40: 15; 17; 20; 86; 54.
3. Multiply the following by 100: 9; 15; 17; 48; 125.
4. Multiply the following by 300: 25; 15; 9; 20; 40.

Solve:

5. When each acre of land yields 20 tons of cabbage, how many tons will 17 acres yield? 25 acres? 13 acres? 28 acres?
6. When land produces 40 bu. of rye per acre, how many bushels will 19 acres produce? 24 acres? 33 acres? 65 acres?
7. If each village block is 300 ft. long, how far do 9 blocks extend? 15 blocks? 29 blocks?

Multipliers Containing Zeros

25. When the multiplier contains zeros, the work is shortened. Thus:

The full work would be:

(1)	(2)
869	624
230	203
<hr/>	<hr/>
000	1872
2607	000
1738	1248
<hr/>	<hr/>
199870	126672

In practice we use only:

(1)	(2)
869	624
230	203
<hr/>	<hr/>
26070	1872
1738	1248
<hr/>	<hr/>
199870	126672

WRITTEN EXERCISES

Multiply:

- | | | |
|--------------------|--------------------|---------------------|
| 1. \$673 × 105. | 5. \$876 × 200. | 9. 624 ft. × 300. |
| 2. 178 gal. × 207. | 6. 144 in. × 120. | 10. 308 yd. × 201. |
| 3. 763 qt. × 408. | 7. 902 lb. × 420. | 11. 777 hr. × 1001. |
| 4. 48 min. × 500. | 8. 1240 lb. × 505. | 12. 630 T. × 420. |

Multiplication of Dollars and Cents

26. When the multiplicand expresses dollars and cents, the product will have two places denoting cents.

Thus, in these examples the two figures at the right in each product indicate the number of cents in the result; for, as soon as the cents in the multiplicand have been multiplied, the cents in the product have been found. The decimal point separates the dollars from the cents.

$$\begin{array}{r}
 \text{(1)} \\
 \$4.25 \\
 \underline{4} \\
 \$17.00 \\
 \text{(2)} \\
 \$4.86 \\
 \underline{19} \\
 43\ 74 \\
 \underline{48\ 6} \\
 \$92.34
 \end{array}$$

WRITTEN EXERCISES

Multiply:

- | | | | |
|-------------------------|-------------------------|--------------------------|--|
| 1. \$4.96
<u>15</u> | 4. \$73.25
<u>5</u> | 7. \$20.08
<u>206</u> | 10. 98¢ = \$.98
<u>17</u> <u>17</u> |
| 2. \$11.25
<u>40</u> | 5. \$9.81
<u>77</u> | 8. \$14.27
<u>19</u> | 11. 48¢ = \$.48
<u>20</u> <u>20</u> |
| 3. \$8.05
<u>76</u> | 6. \$18.65
<u>36</u> | 9. \$112.75
<u>62</u> | 12. 79¢ = \$.79
<u>218</u> <u>218</u> |

Solve:

13. What is the cost of 468 bu. of apples at \$1.35 a bushel?
14. What is the cost of 96 Dictionaries at \$9.80 each?
15. How much does a man earn in 18 months at \$245 a month?

Powers**27. PREPARATORY.**

1. What is the area of a square 2 in. on a side?
2. What is the area of a square 3 ft. on a side? What is such a square called?
3. What is the area of a square flower-bed 4 ft. on a side?
4. How did we find the areas of these squares?
5. Compare the factors in each product:
 $2 \times 2 = 4.$ $3 \times 3 = 9.$ $4 \times 4 = 16.$

28. The product of two equal factors is called the **square** of the repeated factor, or its **second power**.

Thus, in Exercise 5 above, 4 is the square (or second power) of 2; 9 is the square (or second power) of 3; and 16 is the square (or second power) of 4. The square of 2 (or 4) may be written 2^2 ; the square of 3 (or 9) may be written 3^2 . Similarly, $25 = 5^2$; $100 = 10^2$; and so on.

29. The product of three equal factors is called the **cube** or **third power** of the repeated factor.

Thus, $2 \times 2 \times 2$ is the cube or third power of 2, and is written 2^3 . Similarly, $3 \times 3 \times 3 = 3^3$, and so on.

ORAL EXERCISES

1. 25 is the square of what number? 36 is the second power of what number? 49 is the second power of what number?

2. 81 is the second power of what number? 64 is the square of what number? 100 is the square of what number?

3. State orally the squares of all integers from 1 to 10 inclusive.

4. 27 is the cube of what number? 64 is the cube of what number? 1000 is the third power of what number?

5. What is the cube of 4? Of 5? Of 3? Of 2? Of 10?

WRITTEN EXERCISES

Indicate each of the following by the second power of a number :

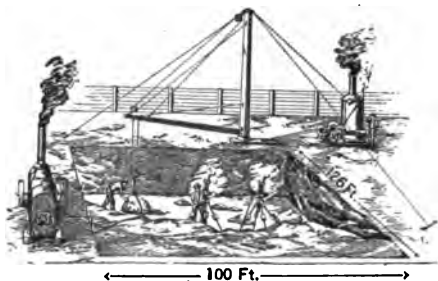
1. The number of days in seven weeks.
2. The number of things in 12 dozen.
3. The number of square feet in a square yard.
4. The number of square inches in a square foot.
5. The number of tens in one hundred.

Solve :

1. A certain building has a floor space 90 ft. wide and 115 ft. long. How many square feet in this space?

2. A building has a cellar 9 ft. deep as shown in the picture. How many cubic feet does the cellar contain?

3. It was necessary to drill and blast. 5 drills were used, each costing \$5 per day to operate. It took 70 days to do the drilling. What did this part of the work cost?



4. A steam boiler was used to supply steam for the drill and for the derrick. Estimating the cost of labor in this service to be \$12 per day, what did it cost for 70 days?

5. The boiler required 2 tons of coke a day, costing \$2.50 per ton. What did the coke cost for 70 days?

6. 15 men were employed at \$1.75 per day for each man. What did the labor cost for the 70 days?

7. 10 wagons each drawing 6 loads of stone daily were used for 70 days. How many loads did they take away in all?

8. A team and driver cost the contractor \$6 a day. How much did the services of 10 teams for 70 days cost?

DIVISION

30. The ease with which we can divide numbers depends upon our knowledge of multiplication.

Thus, to divide 48 by 6 we must know how many 6's in 48.

ORAL EXERCISES

Divide rapidly:

Thus, 6 divided by 3 is 2; say merely "2."

- | | | | | | | | | |
|------------------------|-----|-----|-----|-----|-----|-----|-----|----|
| 1. $3 \overline{) 6}$ | 9, | 15, | 21, | 12, | 24, | 18, | 30, | 27 |
| 2. $4 \overline{) 12}$ | 8, | 20, | 32, | 24, | 40, | 28, | 36, | 16 |
| 3. $5 \overline{) 10}$ | 25, | 35, | 20, | 40, | 15, | 30, | 50, | 45 |
| 4. $6 \overline{) 24}$ | 36, | 12, | 48, | 18, | 60, | 42, | 54, | 30 |

WRITTEN EXERCISES

1—3. Make tables, similar to the above, for 7. For 8. For 9.

$$4. \frac{2 \text{ tens} + 3 \text{ units}}{3 \overline{) 6 \text{ tens} + 9 \text{ units}}} = \frac{20 + 3}{3 \overline{) 60 + 9}} = \frac{23}{3 \overline{) 69}} \quad () ?$$

Copy, and divide:

- | | | | | |
|-------------------------|--------------------------|--------------------------|---------------------------|---------------------------|
| 5. $3 \overline{) 129}$ | 8. $8 \overline{) 648}$ | 11. $8 \overline{) 728}$ | 14. $11 \overline{) 110}$ | 17. $7 \overline{) 427}$ |
| 6. $4 \overline{) 168}$ | 9. $9 \overline{) 549}$ | 12. $6 \overline{) 486}$ | 15. $7 \overline{) 567}$ | 18. $5 \overline{) 250}$ |
| 7. $5 \overline{) 205}$ | 10. $6 \overline{) 426}$ | 13. $4 \overline{) 808}$ | 16. $9 \overline{) 909}$ | 19. $10 \overline{) 200}$ |

31. The process of finding how many times one number is contained in another, or of separating a number into equal parts, is called **division**.

32. The number divided is called the **dividend**.

The number by which the dividend is divided is called the **divisor**.

The result of division is called the **quotient**.

33. EXAMPLE : Divide 912 by 12.

76 Quotient

Divisor $12 \overline{)912}$ Dividend

12 is not contained in 9, but is contained in 91. There are 7 twelves in 91, and 7 remains undivided. Then, 7 tens and the 2 units make 72. 12 is contained 6 times in 72.

Test : $12 \times 76 = 912$.

34. One number is not always contained an exact number of times in another.

The number left undivided, because it is smaller than the divisor, is called the **remainder**.

Thus, 7 is contained 6 times in 45, with 3 over. 3 is the remainder.

It is customary to indicate the division of the remainder by the use of a fraction.

Thus, the division of 45 by 7 is expressed by

$$6\frac{3}{7} \quad 7 \overline{)45}$$

WRITTEN EXERCISES

Divide, and indicate by a fraction the division of whatever remainder there may be :

- | | | | | |
|------------------------|------------------------|------------------------|------------------------|--------------------------|
| 1. $5 \overline{)195}$ | 3. $5 \overline{)206}$ | 5. $8 \overline{)712}$ | 7. $9 \overline{)828}$ | 9. $4 \overline{)1288}$ |
| 2. $7 \overline{)504}$ | 4. $8 \overline{)128}$ | 6. $6 \overline{)384}$ | 8. $6 \overline{)820}$ | 10. $9 \overline{)4572}$ |

Solve :

- Find $\frac{1}{5}$ of \$450. Also $\frac{1}{4}$ of \$504.
- Find $\frac{1}{4}$ of 516 ft. Also $\frac{1}{16}$ of 900 mi.
- Find $\frac{1}{16}$ of 144 sq. in. Also $\frac{1}{16}$ of 1,728 cu. in.
- A man earning \$9 per week received \$108. How many weeks had he worked?
- A stack of 2,250 books has 15 shelves each holding the same number of books. How many books on a shelf?
- 1,730 plants were set 24 in each row. How many rows were there? How many plants were left over?

35. The sign \div is read "divided by."

36. The dividend is the product of the divisor and the quotient. Consequently, the work of division may be tested by seeing if *the divisor \times the quotient equals the dividend.*

Thus, $128 \div 4 = 32$ is correct, because $4 \times 32 = 128$.

37. What is the quotient of 50 ft. divided by 10 ft.?

Dividend		Divisor		Quotient
50 ft.	\div	10 ft.	$=$	5

38. *If the dividend and divisor are concrete numbers, the quotient is an abstract number.*

39. *If both the dividend and the divisor are concrete, they must be like numbers.*

40. What is the quotient of 45 oz. divided by 5?

Dividend		Divisor		Quotient
45 oz.	\div	5	$=$	9 oz.

41. *If the dividend is a concrete number and the divisor an abstract number, the quotient is a concrete number like the dividend.*

WRITTEN EXERCISES

1. How many gallons in 27 quarts?

Solution: One gal. = 4 qt.

$$4 \text{ qt. } \overline{) 27 \text{ qt.}}$$

6 times with 3 qt. over.

6 gal. and 3 qt. = $6\frac{3}{4}$ gal.

2. How many yards in 38 ft.?

3. How many bushels in 42 pk.?

4. How many gallons in a barrel containing 125 qt.?

5. How many weeks in 365 da.?

6. How many feet in 256 in.?

7. How many pounds in 320 oz.?

Division by 10 and by 100**42. PREPARATORY.**

1. Divide 240 by 10.

2. Divide 240 by 20. How does the result differ from the answer to Exercise 1 above?

43. Since multiplying an integer by 10 adds a zero at the right,

An integer ending in zero is divided by 10 by removing that zero.

An integer ending in 0 may be divided by 20 by removing the zero and dividing by 2.

ORAL EXERCISES

1. Divide the following numbers by 10: 20; 700; 60; 50; 150; 290.

2. Divide the following numbers by 20: 40; 140; 80; 280; 400; 1200.

3. How may an integer ending in 0 be divided by 30? 70?

4. An orchard contained 600 trees in 30 equal rows. How many trees in a row?

5. A farmer carted to market 480 bu. of potatoes in loads of 30 bu. each. How many loads did he draw?

44. *An integer ending in two zeros may be divided by 100 by removing two zeros from the right.*

1. Divide 1800 by 100, then divide the result by 2.

2. Divide 1800 by 200. The results are the same.

An integer ending in two zeros is divided by 200 by removing the two zeros and dividing by 2.

Similarly, an integer ending in two zeros is divided by 300 by removing the two zeros and dividing by 3.

ORAL EXERCISES

1. Divide by 100: 300; 500; 1,200; 3,000; 9,900.
2. Divide by 200: 400; 10,000; 800; 900; 1,500.
3. How many an integer ending in two zeros be divided by 300? By 500? By 600? By 800? By 900?
4. A regiment of 1000 soldiers was drawn up in ranks of 200 each. How many ranks were there?
5. 4,900 bu. of grain were shipped in carloads of 700 bu. each. How many cars were used?

45. PREPARATORY.

1. If the units' digit of an integer is subtracted from it, the result ends in zero and is divisible by 10.

Thus, $127 - 7 = 120$, a number divisible by 10.

2. If the number formed by the units' and tens' digits of an integer is subtracted from it, the result ends in two zeros and is divisible by 100.

Thus, $1438 - 38 = 1400$, a number divisible by 100.

- 46.** *To divide any integer by 10 cut off the units' digit, and consider it the remainder.*

EXAMPLE: Divide 389 by 10.

$$\begin{array}{r} 38 \overline{) 389} \\ \underline{380} \\ 9 \end{array}$$

38, the part at the left, is the quotient; and 9, the part at the right, is the remainder.

- 47.** *To divide any integer by 100 cut off the units' and tens' digits, and consider them the remainder.*

EXAMPLE: Divide 5,348 by 100.

$$\begin{array}{r} 53 \overline{) 5348} \\ \underline{5300} \\ 48 \end{array} = 53\frac{48}{100}$$

53, the part at the left, is the quotient; and 48, the part at the right, is the remainder.

WRITTEN EXERCISES

1. Divide by 10: 46; 129; 385; 621; 1,286; 1,955.
2. Divide by 100: 2,936; 945; 186; 625; 1,006; 4,609.
3. A man paid \$658 in 10 equal payments. How many dollars in each payment?

Long Division

48. Division by numbers larger than 12 is usually performed by a process called **long division**.

EXAMPLE: Divide 40,397 by 197.

$$\begin{array}{r}
 5 \\
 200 \\
 197 \overline{)40397} \\
 \underline{39400} \\
 997 \\
 \underline{985} \\
 12
 \end{array}$$

197 is not contained in 40, but is contained twice in 403. Then 197 is contained 200 times in 40,300. Subtracting 200×197 or 39,400 from the dividend, there remains 997.

We find how many times 197 is contained in 997 by noticing how many times 99 contains 19. 197 is contained 5 times in 997. Subtracting 985 from 997, there remains 12. The division ends here because the remainder 12 is less than the divisor 197.

$$\begin{array}{r}
 205 \\
 197 \overline{)40397} \\
 \underline{394} \\
 997 \\
 \underline{985} \\
 12
 \end{array}$$

In actual work a shorter form is used. Thus, 197 is contained twice in 403, hence the first figure of the quotient is 2. Subtract 2×197 from 403. The remainder is 9. Bring down the next figure of the dividend, making 99. 197 is not contained in 99, hence the next figure of the quotient is 0. Bring down the last figure of the dividend, making 997. 197 is contained 5 times in 997, hence the next figure of the quotient is 5. Subtract 5×197 from 997, and the remainder is 12.

Test: $205 \times 197 + 12 = 40,397$.

The first figure obtained in the quotient should be placed over the last figure of the part of the dividend used to find it. Thus, in the example above, 2, in the quotient, is placed over 3 in the dividend.

WRITTEN EXERCISES

Divide and test :

A rapid worker can solve five of these problems correctly in five minutes.

- | | | |
|-----------------------|------------------------|--------------------------|
| 1. $2,090 \div 55$. | 6. $2,672 \div 66$. | 11. $306,954 \div 137$. |
| 2. $1,625 \div 25$. | 7. $23,100 \div 77$. | 12. $816,124 \div 365$. |
| 3. $1,308 \div 19$. | 8. $10,935 \div 63$. | 13. $693,777 \div 707$. |
| 4. $57,602 \div 92$. | 9. $66,888 \div 223$. | 14. $459,678 \div 208$. |
| 5. $10,556 \div 28$. | 10. $33,534 \div 46$. | 15. $539,024 \div 532$. |

Solve :

16. A lot of Oriental rugs at \$65 each cost a dealer \$8,320. How many did he buy?

17. A farm cost \$14,400 at \$75 per acre. How many acres did the farm contain?

18. \$300,625 of prize money was divided equally among 125 sailors. How many dollars did each receive?

19. Rhode Island has a population of 430,000 and an area of 1,250 sq. mi. How many inhabitants has the State per acre?

20. The District of Columbia has an area of 70 sq. mi. and a population of 278,740. How many inhabitants is this per square mile?

21. The total number of station agents employed by the railroads of the United States in a recent year was 32,283; the number per 100 mi. of road was 17. How many miles of railroad in the United States?

22. Some places on the earth are carried by its rotation through 25,000 mi. in 24 hr. How many miles is this per hour? Per minute?

23. Coal is weighed at the mines by the gross ton, 2,240 lb. How many gross tons in 311,360 lb.?

24. An automobile traveled 1,980 mi. in 18 da. What was the rate in miles per day?

Division of Dollars and Cents

49. EXAMPLE: Divide \$196.42 into 14 equal parts.

$$\begin{array}{r}
 \$14.03 \\
 14 \overline{) \$196.42} \\
 \underline{14} \\
 56 \\
 \underline{56} \\
 42 \\
 \underline{42} \\
 00
 \end{array}$$

If the quotient is placed over the dividend as in this solution and as explained in Sec. 48, we shall have found the dollars of the quotient when we have divided the dollars of the dividend; hence the decimal point of the quotient will come directly over the decimal point of the dividend.

WRITTEN EXERCISES

Divide:

- | | | |
|-------------------|-------------------|-------------------|
| 1. \$225.60 ÷ 15. | 4. \$330.34 ÷ 46. | 7. \$169.65 ÷ 13. |
| 2. \$156.25 ÷ 25. | 5. \$105.56 ÷ 28. | 8. \$20.90 ÷ 55. |
| 3. \$168.08 ÷ 48. | 6. \$216.32 ÷ 16. | 9. \$643.06 ÷ 79. |

Solve:

10. 21 wagons, including transportation, cost a dealer \$632.31. What did they cost him per wagon?

11. A stock dealer bought 31 Mexican horses, which cost him delivered \$837.31. How much was this per horse?

12. A house cost its builder \$4,650; its floor area was 1,500 sq. ft. How much did it cost per square foot of floor space?

13. A broker sold 105 bales of cotton for \$5,853.75. How many dollars did he receive per bale?

14. A real estate agent sold 43 lots for \$5,439.50. How much was this per lot?

15. If a man's salary is \$2,250 a year, how much does he earn per week?

16. A fund of \$25,180.75 was applied to the relief of 18,000 persons. How much was this per person?

CASH ACCOUNTS

50. It is desirable to keep an account of money received and paid out. Such a record is called a **cash account**.

1909 Cash Dr			1909 Cash Cr.		
Feb. 1	To Wages	\$52 00	Feb. 1	By Fuel	\$18 50
Mar. 1	" "	48 00	Feb. 1	" Clothing	17 75
Apr. 1	" "	52 00	Mar. 1	" Rent	36 00
			Apr. 1	Washing	5 00
	Total			Balance	
				Total	

Dr. stands for debtor, and *Cr.* for creditor. *Cash* may be thought of as a person holding the cash, hence as a debtor to the person keeping the account for all money received and as creditor for all money paid out.

51. Finding how much must be added to one side of an account to make the footings of the two sides equal is called **balancing** the account.

The double lines under the columns show that the account has been balanced to date, and that the amount on hand, if such there be, is the same as the balance on the credit side.

1. On which side of the account are entered the amounts of money, or cash, received? On which side are entered the amounts of money, or cash, paid out?

2. In the account on page 40, on what items was money received from January 1 to April 1?
3. What is the total of the debit side? Of the credit side?
4. How much should be entered opposite the word *balance* to make the footing of the credit side also \$152?

WRITTEN EXERCISES

Find the balance in each of these accounts:

1. Mr. Minor had on hand, March 1, \$5. Earned to March 20, \$25. March 31, sold a watch for \$15. March 10, purchased a pair of shoes for \$4. March 30, paid for board, \$10.

2. Received, May 1, \$25.25. Received, May 2, \$50. Bought, May 5, a suit of clothes for \$14.50. Paid board, May 20, \$9. Incidentals to May 30, \$5.75. Received May 31, a month's wages, \$62.

3. Balance on hand, July 1, \$335. Received from rents, July 3, \$75. Paid for board, July 15, \$35. Paid for laundry, July 18, \$3.35. Paid for incidentals, July 20, \$28.87.

4. On hand, May 1, \$25. Received for wages, May 15, \$5. Paid for board, May 16, \$7.50. Paid note, May 20, \$25. Received for wages, May 31, \$40.

5. On hand, July 1, \$365. Paid for labor, July 3, \$12.45. Paid for groceries, July 5, \$18.35. Received interest, July 8, \$175. Paid for dry-goods, July 15, \$67.75. Paid taxes, July 23, \$95.75.

6. On hand, Apr. 1, \$25. Paid rent, Apr. 2, \$15.50. Paid labor, Apr. 15, \$17.75. Paid for merchandise, Apr. 25, \$500.66. Received by sale of merchandise to Apr. 28, \$600.25.

7. Balance on hand, Jan. 1, \$500. Received from rents, March 1, \$50; July 1, \$75; Dec. 1, \$125. Received from interest, Nov. 1, \$205. Paid grocery bills, Apr. 1, \$45.75; July 1, \$60; Dec. 5, \$75. Paid dry-goods bill, Sept. 1, \$100.75. Paid for incidentals to Dec. 31, \$125.35.

MONEY-ORDERS

52. Money may be paid by means of postal **money-orders**, which are obtainable at post-offices, or by means of express money-orders obtainable at the offices of the express companies.

100 DOLLARS 90 DOLLARS 80 DOLLARS 70 DOLLARS 60 DOLLARS 50 DOLLARS 40 DOLLARS 30 DOLLARS 20 DOLLARS 10 DOLLARS 5 DOLLARS 1 DOLLAR 50 CENTS 25 CENTS 10 CENTS 5 CENTS 1 CENT	American Express Company MONEY ORDER		# 1259064
	WHEN COUNTERSIGNED by the authorized Agent, this Company will transmit and pay the HIGHEST PAYABLE AMOUNT. AMOUNT FOR DOLLARS NOT EXCEEDING FIFTY DOLLARS and written figures for CENTS, on per conditions hereon.		
	To the Order of <u>L. C. Mason</u>		<i>Forw'd by Air</i> 1.25
	243 W. 125th ST. NEW YORK CITY.		
	STATE _____ COUNTY _____ CITY _____		
	SIGNED: <u>[Signature]</u>		
	(Name of Agent) <u>[Signature]</u>		
	Any erasure, alteration, defacement or mutilation of this Order renders it VOID.		

The fees for postal money-orders, payable in the United States (including Hawaii, Porto Rico and the Philippines), in Canada, and in Cuba, are:

For orders for sums not exceeding	\$2.50,	3¢
" " over	\$2.50 and not	" 5.00, 5¢
" " " 5.00	" " " 10.00,	8¢
" " " 10.00	" " " 20.00,	10¢
" " " 20.00	" " " 30.00,	12¢
" " " 30.00	" " " 40.00,	15¢
" " " 40.00	" " " 50.00,	18¢
" " " 50.00	" " " 60.00,	20¢
" " " 60.00	" " " 75.00,	25¢
" " " 75.00	" " " 100.00,	30¢

WRITTEN EXERCISES

1. Carl sent for a camera which cost \$15; a tennis-racket, \$3.75; and a rifle, \$25. What was the fee for the money-order sent in payment? What was the total cost?

2. What is the fee for a money-order for \$1.75? For \$2.50? For \$2.55? For \$4.20? For \$6? For \$18?

3. A lady ordered a rug for \$25; 20 yd. of carpet at \$1.32 a yard; and a couch cover for \$8.75. What did she pay for all? What was the total cost of the money-order?

4. A musician ordered a mandolin for \$8; a guitar for \$7.50; a violin for \$55.75; and a banjo for \$12. What was the total cost of the money-order?

5. Mr. Mason bought of Ward and Company 1 box of soap at \$4; 1 bbl. of flour, \$3.50; and 50 lb. of dried meat at 9 cts. a pound. What was the cost of a money-order to pay for these goods?

6. Mrs. Martin bought of Thomas Smith 3 yd. of lace at \$.65 a yard; 1 doz. handkerchiefs for \$4.75; 4 yd. of silk at \$1.15 a yard; and a table-cloth for \$8. What was the cost of the money-order to pay for these goods?

7. Mr. Carr bought of Milton Woodward & Co. a harness for \$25; a saddle for \$21.85; a horse-blanket for \$3.75; and a set of sleigh-bells for \$2.75. What did he pay for all? What was the total cost of the money-order?

State the cost of a money-order with which to pay each of the following bills:

8. Bought 25 suits of clothing at \$9.50 each and 15 overcoats at \$16.25 each.

9. Bought 7 copies of Eliot's "Silas Marner" at 35 cts. a copy, 12 copies of Milton's "Paradise Lost," at \$1.25 a copy, and 15 Coleridge's "Ancient Mariner" at 40 cts. a copy.

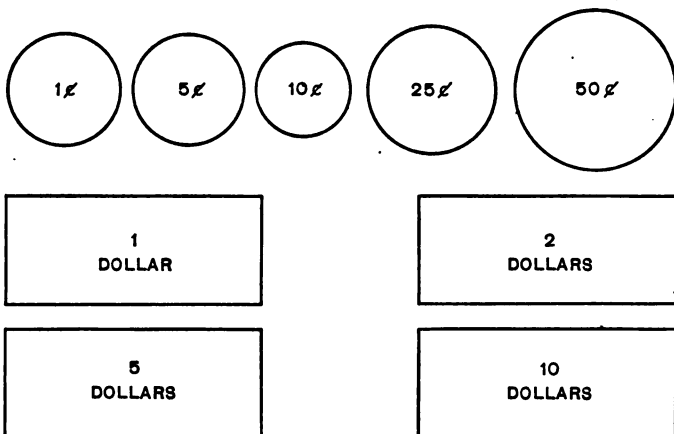
10. Bought 40 lb. of nails at 3 cts. a pound, 25 yd. of wire netting at 95 cts. a yard, and 3 axes at \$1.50 each.

11. Bought 3 sleds for \$2.50 each, and 5 pairs of skates at \$1.75 each.

12. Bought 25 copies of *Appleton's Magazine* at 15 cts. a copy and 38 copies of the *Saturday Evening Post* at 5 cts. a copy.

KEEPING STORE

53. Prepare and mark paper forms similar to these:

MONEY**ARTICLES FOR SALE**

a HAT 75¢	b SKATES \$ 1.25	c READER 30¢	d CANDY 35¢
e 1 TON COAL \$ 6.75	f 1 SK. FLOUR \$ 1.20	g 1 BU. POTATOES 60¢	h 1 LB. SUGAR 5¢
i 1 LOAF BREAD 5¢	j 1 CAKE 40¢	k 1 DOZ. ORANGES 30¢	l WAFERS 10¢

As many sets may be made as are needed for the work; other tickets representing articles for sale may be made.

1. Some pupils may act as salesmen and others as customers. Let each customer take at least 3 articles and pay for them in money, offering the correct amount.

2. Let each customer take 3 articles and pay with the smallest single piece of money whose value exceeds his purchase. Require the salesman to make the correct change.

ORAL EXERCISES

1. Carl, acting as buyer, purchased the three articles in the first column on page 44; that is, those shown by tickets *a, e, i*. How much did they cost?

2. Susie purchased those in the second column; that is, *b, f, j*. How much did she pay for them?

3. Myron purchased *d, h, l*. How much did they cost?

Find the cost of:

4. *a, b, c, d.*

7. *e, f, g, h.*

10. *i, j, k, l.*

5. *a, b, c, f.*

8. *e, f, i, j.*

11. *g, h, k, l.*

6. *c, d, g, h.*

9. *b, c, f, g.*

12. *f, g, j, h.*

WRITTEN EXERCISES

1. Write the names of the articles and prices indicated in Exercises 4 and 5 above. Find their total cost.

Find the total cost after writing the names and prices of the articles indicated in the exercises above:

2. 4 and 6.

7. 5 and 6.

12. 7 and 8.

3. 8 and 9.

8. 7 and 9.

13. 10 and 11.

4. 10 and 12.

9. 11 and 12.

14. 4, 7, and 10.

5. 5, 8, and 11.

10. 6, 9, and 12.

15. 4, 5, and 6.

6. 7, 8, and 9.

11. 10, 11, and 12.

16. 6, 8, and 10.

17. Write a bill with your own name as purchaser, and another pupil's name as dealer, for the items indicated in Oral Exercise 11. (See page 10 for a correct form of bill.)

18. Similarly, write a bill for the items indicated in Written Exercise 4. Also 5. Also 11. Also 16.

POSTAGE PROBLEMS

54. Domestic Postage: The following are the rates to all parts of the United States, including Hawaii, Porto Rico, and the Philippine Islands. The same rates apply to England, Canada, Mexico, and Cuba.

FIRST-CLASS MATTER: Letters or sealed matter 2 cents an ounce or fraction thereof. Postal cards 1 cent each; with paid reply card, 2 cents each.

SECOND-CLASS MATTER: Newspapers and other periodical publications, when sent by publishers or news-agents, 1 cent per pound or fraction thereof; when sent by others, 1 cent for each four ounces or fractional part thereof.

1. What is the postage on a letter weighing $\frac{3}{4}$ oz.? $2\frac{1}{2}$ oz.? $4\frac{1}{4}$ oz.? $1\frac{3}{4}$ oz.? $1\frac{1}{2}$ oz.? 3 oz.? $6\frac{1}{2}$ oz.?

2. A publisher sends 15,000 copies of his paper by mail. Each paper with its wrapper weighs $4\frac{1}{2}$ oz. He pays for the total weight at 1 ct. per lb. What is his postage bill?

3. One of the subscribers remails his copy to a friend. How much postage must he pay?

4. Anna found that one of the monthly magazines weighed $13\frac{1}{4}$ oz. If 125,000 copies of it were sent by mail, what was the postage bill of the publisher for that month?

5. What is the greatest weight a newspaper can have that requires 3 cts. postage when remailed?

6. How many ounces or less does a letter weigh on which the postage is 6 cts.?

7. A manuscript weighs 1 lb. $1\frac{1}{4}$ oz. What is the postage on it at letter rate?

8. What is the cost of a gross of postal cards with paid reply cards? What is the cost of 500?

9. What is the postage on 10,000 copies of a 4-oz. newspaper when sent by the publisher?

FACTORS AND MULTIPLES

Divisibility

55. PREPARATORY.

1. Name the multiples of 2 from 2 to 30. If each of these multiples is divided by 2, what is the remainder?

These numbers are said to be *divisible* by 2.

2. Name the multiples of 3 from 3 to 30. If each of these multiples is divided by 3, what is the remainder?

These numbers are said to be *divisible* by 3.

56. An integer which can be divided by another integer without a remainder is said to be **divisible** by the other integer.

57. Integers divisible by 2 are called **even numbers**, and all other integers are called **odd numbers**.

58. EASY TESTS OF DIVISIBILITY:

1. An integer is divisible by 2 if the units' figure is even.

2. An integer is divisible by 4 if the 2 figures at the right represent a number divisible by 4.

Thus, 1,524 is divisible by 4, because 24 is divisible by 4.

3. An integer is divisible by 3 if the sum of its digits is divisible by 3.

Thus, 24,120 is divisible by 3, because $2 + 4 + 1 + 2 + 0 = 9$ is divisible by 3.

4. An integer is divisible by 5 if the units' figure is 0 or 5.

5. An integer is divisible by 8 if the last three figures at the right represent a number divisible by 8.

Thus, 56,816 is divisible by 8, because 816 is divisible by 8.

6. An integer is divisible by 9 if the sum of its digits is divisible by 9.

Thus, 24,129 is divisible by 9, because $2 + 4 + 1 + 2 + 9 = 18$ is divisible by 9.

Factors and Divisors

59. An integer divisible only by itself and one is called a **prime number**. Numbers not prime are **composite numbers**.

Thus, 2, 3, 5, 7, are prime numbers; 4, 6, 8, 14, are composite.

60. The numbers that, multiplied together, form a product are called the **factors** of the product. Every factor of a number is a divisor of it.

Thus, in $2 \times 5 \times 4 = 40$, 2, 5, and 4 are factors and divisors of 40.

61. Factors, or divisors, that are prime numbers are called **prime factors** or **prime divisors**.

62. Finding the prime factors or divisors of a number is called **factoring** the number.

EXAMPLE: Find the prime factors of 4,158.

The last digit, 8, is even; hence one divisor is 2.

The quotient 2,079 is divisible by 3, since $2 + 0 + 7 + 9 = 18$, which is divisible by 3.

$$2) \underline{4158}$$

$$3) \underline{2079}$$

$$3) \underline{693}$$

$$3) \underline{231}$$

$$7) \underline{77}$$

$$11$$

The next quotient 693 is divisible by 3 for the same reason; so also is the next.

The next quotient, 77, is evidently a multiple of 7; therefore the prime factors of 4,158 are 2, 3, 3, 3, 7, and 11.

Test: $2 \times 3 \times 3 \times 3 \times 7 \times 11 = 4,158$.

After dividing by 2, the quotient is divisible by 9 because $2 + 0 + 7 + 9 = 18$, is divisible by 9. The work might be shortened by dividing by 9 instead of by 3 and writing 3×3 for the divisor 9 in the result.

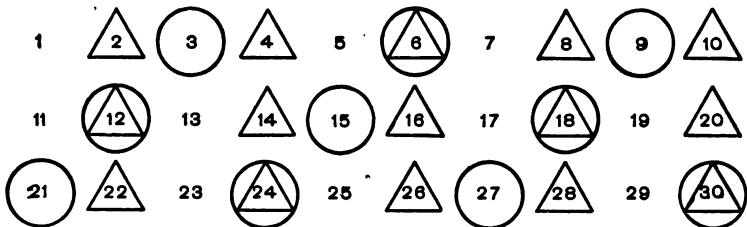
WRITTEN EXERCISES

Find the prime factors of:

- | | | | | |
|-----------|-----------|-----------|------------|------------|
| 1. 210. | 4. 5,390. | 7. 1,485. | 10. 2,178. | 13. 1,182. |
| 2. 2,240. | 5. 288. | 8. 3,645. | 11. 1,000. | 14. 6,160. |
| 3. 2,427. | 6. 1,625. | 9. 625. | 12. 2,121. | 15. 6,250. |

Common Divisors**63. PREPARATORY.**

1. Find the numbers in the table that are divisible by 2. Read those divisible by 3.



2. By what form are all the numbers divisible by 2 enclosed?

3. By what form are all the numbers divisible by 3 enclosed?

4. How are all the numbers divisible by both 2 and 3 enclosed?

64. Two numbers that are divisible by the same number are said to have a **common divisor**.

ORAL EXERCISES

1. Name a common divisor of all the numbers in the table. Of the numbers enclosed by a triangle. By a circle.

2. Name a common divisor of the numbers enclosed by both a triangle and a circle.

WRITTEN EXERCISES

1. Write on the board in ten rows the numbers from 1 to 100. Cross in white all the even numbers; in red all the numbers divisible by 3; in yellow all the numbers divisible by 5.

2. What kind of numbers are those not crossed? Are there any odd numbers crossed?

3. What digits occupy units' place in all numbers divisible by 5?

4. With what colors are the numbers divisible by 2 and by 3 crossed? Read these numbers. Read the multiples of 6 from the table.

5. Read the numbers not divisible by 2, by 3, and by 5.

6. What common divisor have all even numbers? All multiples of 3? Of 5? Of 12?

Find a common divisor of each pair of numbers :

7. 18, 27. 9. 24, 36. 11. 16, 40. 13. 15, 35.

8. 45, 30. 10. 22, 55. 12. 21, 56. 14. 39, 26.

15. Name the fractions of the following list in which the numerator and the denominator have a common divisor:

$\frac{2}{4}$ $\frac{3}{5}$ $\frac{4}{6}$ $\frac{5}{8}$ $\frac{3}{8}$ $\frac{6}{8}$ $\frac{5}{10}$ $\frac{4}{100}$ $\frac{25}{100}$ $\frac{17}{25}$ $\frac{9}{10}$.

65. The largest number that will divide each of two or more numbers is called their **greatest common divisor**. This name is abbreviated by using **g. c. d.**

66. *To find the greatest common divisor of several numbers, first separate the numbers into their prime factors; then multiply together all the common factors, taking any repeated factor as many times as it is found in the number where it occurs least often.*

EXAMPLE: Find the greatest common divisor of 36 and 56.

Solution: Since, $36 = 3 \times 3 \times 2 \times 2$,

and $56 = 7 \times 2 \times 2 \times 2$,

the greatest common divisor of 36 and 56 is 2×2 or 4.

WRITTEN EXERCISES

Find the greatest common divisor of each set :

1. 18, 45, 1089.

4. 1024, 1728.

7. 625, 1800.

2. 88, 121, 2244.

5. 3645, 5390.

8. 2121, 1484.

3. 48, 210, 288.

6. 2412, 6600.

9. 144, 1728.

Find the greatest common divisor of the numerator and denominator of each fraction :

10. $\frac{210}{288}$.

12. $\frac{121}{2244}$.

14. $\frac{147}{189}$.

16. $\frac{1000}{6250}$.

11. $\frac{1484}{2828}$.

13. $\frac{1024}{7168}$.

15. $\frac{1182}{2400}$.

17. $\frac{216}{6160}$.

Multiples

67. The result of multiplying a number by an integer is a **multiple** of the number.

Thus, in $3 \times 7 = 21$ the result, 21, is a multiple of 3.

68. PREPARATORY.

1. Write the multiples of 3 from 3 to 39. Of 4 from 4 to 40.
2. What numbers are found in both sets?

69. An integer that is a multiple of other integers is called a **common multiple** of those integers.

Thus, 21 is a common multiple of 3 and 7.

ORAL EXERCISES

1. What are the common multiples of 3 and 4 as far as 48? Which is the smallest of these multiples?

2. What are the common multiples of 4 and 5 as far as 60? Which is the smallest of these multiples?

3. Some boys formed a military company and found that they could march 3, 4, or 5 abreast in full ranks. What number is a multiple of 3, 4, and 5? What is the least number that is a multiple of 3, 4, and 5? What is the least number of boys that could have been in the company?

70. The smallest common multiple of two or more numbers is called their **least common multiple**. This name is abbreviated by using **l. c. m.**

ORAL EXERCISES

1. What is the least common multiple of 4 and 6? Of 5 and 6? Of 3 and 5? Name common multiples for each set.

Find by inspection the least common multiple of:

- | | | | |
|----------|-----------|--------------|--------------|
| 2. 6, 9. | 4. 4, 8. | 6. 3, 4, 6. | 8. 4, 8, 10. |
| 3. 4, 6. | 5. 8, 10. | 7. 3, 5, 10. | 9. 5, 6, 15. |

71. *To find the least common multiple, factor the given numbers and multiply together all the different prime factors. If any factor occurs more than once in any one of the numbers, take it as many times as it is found in the number where it occurs most often.*

72. EXAMPLE: Find the least common multiple of 12, 21, 39.

The prime factors are 2, 3, 7, and 13.

$$24 = 2 \times 2 \times 2 \times 3.$$

$$28 = 2 \times 2 \times 7.$$

$$39 = 3 \times 13.$$

The factor 2 is repeated in two of the numbers. It occurs most often in the first, namely, 3 times; hence it must occur 3 times in the least common multiple.

Therefore, the l. c. m. equals $2 \times 2 \times 2 \times 3 \times 7 \times 13 = 2184$.

WRITTEN EXERCISES

Find, by factoring, the least common multiple of:

- | | | |
|------------|------------|----------------|
| 1. 36, 42. | 4. 18, 28. | 7. 12, 18, 27. |
| 2. 27, 24. | 5. 14, 28. | 8. 25, 60, 10. |
| 3. 14, 22. | 6. 22, 32. | 9. 32, 48, 72. |

10. A florist when decorating a hall found that he had just enough roses to enable him to put either 12, 15, or 18 roses into each vase and have no roses left. How many roses did he have?

11. Harry could spend all of his money by buying tops at 10 cts. each or at 15 cts. each, or at 25 cts. each. How much money did he have?

WRITTEN EXERCISES

Find the l. c. m. of the denominators in each set:

1. $\frac{1}{10}, \frac{7}{12}, \frac{5}{18}$. 3. $\frac{7}{18}, \frac{8}{27}, \frac{13}{99}$. 5. $\frac{1}{18}, \frac{11}{36}, \frac{19}{45}$. 7. $\frac{9}{25}, \frac{8}{15}, \frac{1}{10}$.
 2. $\frac{4}{15}, \frac{7}{30}, \frac{11}{75}$. 4. $\frac{5}{32}, \frac{7}{48}, \frac{11}{64}$. 6. $\frac{1}{21}, \frac{2}{49}, \frac{8}{63}$. 8. $\frac{1}{11}, \frac{1}{77}, \frac{1}{121}$.

Cancellation

73. PREPARATORY.

1. How many times are 2 apples contained in 4 apples?
2. How many times are 2 threes contained in 4 threes?
3. How many times are 2×3 contained in 4×3 ?
4. How many times is $2 \times$ any number contained in $4 \times$ any number?

Since dividing 4×3 by 2×3 is the same as dividing 4 by 2, we may cancel, or cross, the 3 in the dividend and in the divisor without changing the quotient. When written in fractional form the work appears thus:

$$\frac{4 \times 3}{2 \times 3} = \frac{4 \times \cancel{3}}{2 \times \cancel{3}} = \frac{4}{2} = 2.$$

74. The same factors can be canceled from the divisor and the dividend without changing the quotient.

$$\text{EXAMPLE: } \frac{\overset{1}{\cancel{3}} \times \overset{1}{\cancel{7}} \times \overset{1}{\cancel{11}}}{\underset{1}{\cancel{5}} \times \underset{1}{\cancel{3}} \times \underset{1}{\cancel{7}} \times \underset{1}{\cancel{11}} \times 13} = \frac{1}{5 \times 13} = \frac{1}{65}.$$

WRITTEN EXERCISES

Write in the above form and divide by cancellation:

1. $12 \times 28 \times 77$ divided by $8 \times 24 \times 154$.
2. $25 \times 18 \times 11$ divided by $5 \times 11 \times 3$.
3. $35 \times 63 \times 121$ divided by $15 \times 77 \times 11$.
4. $900 \times 360 \times 55$ divided by $12 \times 5 \times 2 \times 11$.

REVIEW

ORAL EXERCISES

1. What are the names of the first four orders in a whole number?

2. What is the name of the seventh order in a whole number? What is the name of the third period?

3. It costs 25 cts. to telephone from a certain city to another, 3 minutes being allowed for conversation; 10 cts. is charged for each additional minute. What does it cost to telephone for 5 minutes between those cities?

4. The cost of a telegram of 10 words (or less) between Syracuse and Rochester is 25 cts., and 2 cts. for each word above 10. (This rate is expressed thus: 25-2.) State the cost to send between these places the following message:

Can not come this week; business prevents; arrive New York City Tuesday; will write.

5. What would it cost to send a 12-word message from Chicago to New York City at 40-3? A 14-word message?

6. State the cost of sending, at the rate given, a 15-word day message from Chicago to each of the following cities:

PLACE.	RATE.		PLACE.	RATE.	
	Day.	Night.		Day.	Night.
San Francisco...	75-5	75-5	New Orleans.....	50-3	30-2
Detroit.....	25-2	25-1	Galveston, Texas..	60-4	40-3
New York.....	40-3	30-2	Kansas City, Mo..	30-2	25-1

NOTE.—Address and signature are free.

7. What would be the cost of sending a 15-word night message to each?

8. What is the cost of a 25-word day message to each?

WRITTEN EXERCISES

Write :

1. Three million, two hundred seventy thousand, sixty-five.
2. Twenty-five million, ninety thousand, one hundred twenty.
3. Eighty-seven million, eighty-seven thousand, forty-nine.
4. Twenty million, forty thousand, one hundred forty.
5. In Roman notation: 19; 26; 35; 39; 43; 56; 49; 100; 97; 63; 45; 90; 75.
6. The squares of 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. In what different figures do these squares end? Then, in what figures may the squares of integers end?

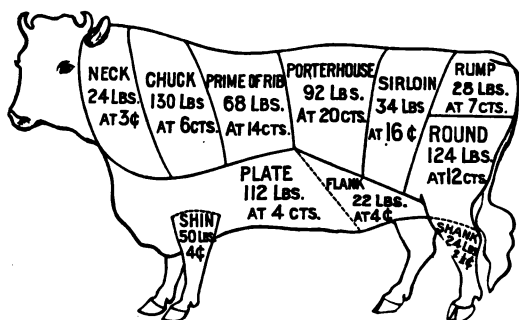
Solve :

7. What is the g. c. d. of 156 and 1728? Of 144 and 256?
8. What is the l. c. m. of 121, 77, 14? Of 14, 196, and 1794?
9. Simplify by cancellation $\frac{18 \times 49 \times 121}{12 \times 90 \times 77 \times 54}$.
10. Simplify by cancellation $\frac{24 \times 38 \times 95}{6 \times 15 \times 361}$.
11. A merchant gained \$1,325.75 the first year, \$2,195.50 the second year, and lost \$989.85 the third year. How many dollars did he gain in the three years?
12. A ranchman paid \$565 for sheep, \$1,250 for cattle, and \$863 for horses. How much had he left out of \$3,000?
13. A landowner received \$25,673 from the sale of lands and \$2,565 for rent, and expended \$565 for repairs. How much had he left?
14. A conductor received on one trip \$9.45 in fares. Of this amount, $\frac{1}{4}$ was in nickel coins and the rest in dimes. How many dimes did he receive?

15. A man started in business with \$2,765.25 in cash and a stock of goods worth \$5,850.25. At the end of the first year he had \$3,650.50 in cash and a stock of goods worth \$4,985. Did he gain or lose, and how much?

16. A man bought a horse and carriage for \$300.50. He sold the horse for \$125 at a loss of \$50.50. What was the cost of the carriage?

17. The diagram shows the different kinds of meats as obtained by a standard method of cutting beef. The figures are



approximate. Find the total weight of beef in one animal as shown in the diagram.

18. Find the value of each kind of beef, and the total value of one animal.

19. Which kind contains the greatest number of pounds? The least? Which has the greatest value per pound? The greatest total value?

20. The following table gives the parts into which dressed mutton is cut for market, and the average price of each kind. Find the number of pounds in an animal and the total value.

Leg.....	22.5 lb., 10¢.	Rib.....	14.5 lb., 9¢.
Loin.....	17.5 lb., 9¢.	Chuck.....	19.8 lb., 1½¢.

21. Answer questions about mutton similar to those in Exercise 19.

FOOD AND PRODUCTS.	ROSE.	NORA.
Food consumed:	<i>Pounds.</i>	<i>Pounds.</i>
Clover hay.....	3,873.10	3,547.50
Corn silage and green corn.....	8,107.50	8,082.00
Rape.....	2,482.00	2,482.00
Cowpeas.....	750.00	750.00
Corn meal.....	1,692.70	1,653.50
Wheat bran.....	1,256.50	1,158.00
Ground oats.....	670.10	567.60
Gluten meal.....	516.50	573.00
Old process linseed-meal.....	848.00	785.30
Milk produced.....	11,329.00	7,759.40
Butter fat produced.....	564.82	298.64

22. The table shows the foods consumed by two cows, and the milk and butter produced by them in one year. Find the total number of pounds of food consumed by each animal in the year.

23. Find the difference in the amounts of milk produced. In the amounts of butter produced.

24. If the milk weighed 2.3 lb. per quart, how many quarts did each cow produce in a year?

25. What is the total value of the milk produced by each cow at 5 cts. a quart? Of the butter at 16 cts. a pound?

26. If $\frac{1}{4}$ lb. of butter is lost per 100 lb. of milk by setting in pans instead of using a separator, how many pounds of butter are lost by setting 800 lb. of milk in pans? What is the money loss, if butter is worth 20 cts. a pound?

27. If the loss is $\frac{1}{4}$ of the total butter product, how many pounds of butter does 1 ton of milk yield?

28. A good cow averages 5,000 lb. of milk a year. How many pounds of butter are lost by setting the milk in pans? What would be the amount of loss when butter is worth 32 cts. a lb.?

29. The coinage of gold at the United States mints in 1880 was \$62,308,279; in a recent year it was \$99,272,942.50. How much more was coined in the latter year than in 1880?

30. If the wages of 10,000 men in the employ of a certain company are cut 10 cts. a day, how many dollars will the company save in wages in a year of 300 working-days?

31. The Canadian power canal at Sault de Ste. Marie furnishes 20,000 horse-power. The canal on the Michigan side furnishes $2\frac{1}{2}$ times as much. How many horse-power does the latter furnish?

32. In a profit-sharing concern each employee earning \$500 a year receives a dividend equal to $\frac{1}{4}$ of his wages. How much does he receive from the company in a year?

33. There were 150,000 automobiles in use in the United States in a recent year. Their total value was \$245,400,000. If the cars were of equal value what was the value of each?

34. In this country fifty companies, whose average capital is \$300,000, manufacture automobiles. What is the total capital of these companies?

35. In a recent year 1,540 automobiles were imported from foreign countries, $\frac{2}{3}$ of which were from France. How many came from other countries?

36. There are 1,200 Sunday schools in France and 38 times as many in Great Britain and Ireland. How many are there in the latter country?

37. South America has 350 Sunday schools averaging 425 pupils each. How many pupils in all of these schools?

38. A large power station has four electric dynamos making 7,000 horse-power each and six making 11,500 horse-power each. How many horse-power does the station furnish?

39. A coast line company has 8 steamers running out of New York, having an average capacity of 965 passengers. What is their total capacity?

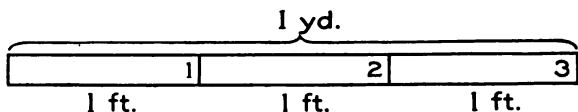
CHAPTER II

COMMON FRACTIONS

75. One or more of the equal parts of a unit, or of a quantity thought of as a whole thing, is called a **fraction**.

76. PREPARATORY.

1. How many feet in a yard? When the yard measure is divided into feet, how many spaces are marked off?



2. What part of the whole is one of these spaces? What parts are two of them? Three of them?

3. When a quantity is divided into 3 equal parts, what are the parts called? In the fractions $\frac{1}{3}$ and $\frac{2}{3}$, which numbers show that the fractions express thirds?

77. The number that names the kind of parts expressed by the fraction is called the **denominator** of the fraction.

The number that tells how many parts are expressed by a fraction is called the **numerator**.

The numerator and the denominator are called the **terms** of the fraction.

ORAL EXERCISES

1. In $\frac{7}{8}$ what is the numerator? What is the denominator?

2. Answer the same questions for $\frac{5}{16}$. For $\frac{3}{8}$. For $\frac{4}{9}$. For $\frac{7}{10}$. For $\frac{2}{11}$.

Read :

- | | | | | |
|----------------------|----------------------|-----------------------|-------------------------|--------------------------|
| 3. $\frac{12}{28}$. | 5. $\frac{43}{84}$. | 7. $\frac{17}{45}$. | 9. $\frac{1}{102}$. | 11. $\frac{84}{197}$. |
| 4. $\frac{5}{411}$. | 6. $\frac{5}{500}$. | 8. $\frac{11}{216}$. | 10. $\frac{24}{1001}$. | 12. $\frac{200}{1212}$. |

WRITTEN EXERCISES

Write in figures :

- Twenty-five thirty-sixths.
- Seventeen eighty-fifths.
- Thirty one-hundred-firsts.
- Three hundred thousandths.
- Five five-hundredths.
- Two hundred one three-hundred-firsts.
- Two hundred five three-thousand-five-hundred-tenths.
- Fifty-nine and nineteen ninety-firsts.

Write in words :

- | | | | |
|------------------------|-------------------------|--------------------------|-----------------------------|
| 9. $\frac{32}{95}$. | 12. $\frac{17}{108}$. | 15. $\frac{123}{155}$. | 18. $50\frac{5}{502}$. |
| 10. $\frac{1}{1001}$. | 13. $\frac{41}{144}$. | 16. $\frac{423}{2621}$. | 19. $\frac{500}{5012}$. |
| 11. $38\frac{2}{25}$. | 14. $\frac{201}{501}$. | 17. $\frac{4}{400}$. | 20. $190\frac{190}{2000}$. |

78. A fraction with the numerator 1 is called a **unit fraction**.

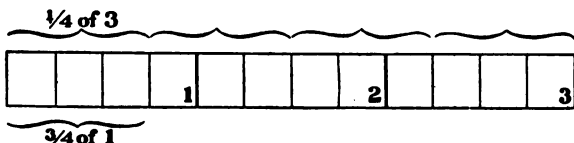
Thus, $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{10}$, $\frac{1}{25}$, $\frac{1}{100}$ are unit fractions. Each expresses *one* part of a whole thing.

The unit fraction in $\frac{3}{10}$ is $\frac{1}{10}$; in $\frac{4}{5}$ is $\frac{1}{5}$; in $\frac{12}{100}$ is $\frac{1}{100}$, and so on.

79. Fractions with the same denominator are said to be **expressed in the same unit**.

80. PREPARATORY.

How many fourths are there in 3 in.? $\frac{3}{4}$ of an inch is what part of 3 in.? Point this out in the figure at the top of page 61.



$\frac{3}{4}$ of an inch = $\frac{1}{4}$ of 3 inches, or 3 inches divided by 4.

81. A fraction means the quotient obtained by dividing the numerator by the denominator.

Thus, $\frac{14}{7}$ means 14 divided into 7 equal parts, or $14 \div 7$, which is 2.

Similarly, $\frac{1}{2}$ means 1 divided into 2 equal parts, or $1 \div 2$, which is $\frac{1}{2}$.

82. A fraction equal to, or greater than, 1 is called an **improper fraction**. A fraction less than 1 is called a **proper fraction**.

Thus, $\frac{2}{3}$, $\frac{14}{7}$, $\frac{13}{3}$ are improper fractions; and $\frac{2}{3}$, $\frac{1}{2}$, $\frac{9}{16}$ are proper fractions.

83. PREPARATORY.

1. Perform the division of $13 \div 6$, indicating the division of the remainder.

Thus, $1\frac{3}{6} = 2\frac{1}{2}$.

2. Perform the division of $15 \div 8$, indicating the division of the remainder.

Thus, $1\frac{7}{8} = 1\frac{7}{8}$.

84. A number that is expressed by a whole number and a fraction is called a **mixed number**.

Thus, $2\frac{1}{2}$ and $1\frac{3}{4}$ are mixed numbers.

ORAL EXERCISES

1. In a proper fraction, which is larger, the numerator or the denominator? In an improper fraction?

Point out the improper fractions :

- | | | | |
|----------------------|----------------------|-----------------------|----------------------|
| 2. $\frac{3}{5}$. | 6. $\frac{11}{8}$. | 10. $\frac{12}{4}$. | 14. $\frac{16}{5}$. |
| 3. $\frac{4}{9}$. | 7. $\frac{9}{4}$. | 11. $\frac{12}{7}$. | 15. $\frac{9}{20}$. |
| 4. $\frac{21}{21}$. | 8. $\frac{24}{7}$. | 12. $\frac{16}{28}$. | 16. $\frac{36}{9}$. |
| 5. $\frac{42}{14}$. | 9. $\frac{25}{28}$. | 13. $\frac{23}{24}$. | 17. $\frac{8}{17}$. |

18. State the whole number or mixed number equal to each improper fraction in the list above.

Express as mixed numbers :

- | | | | |
|-----------------------|-----------------------|-----------------------|-------------------------|
| 19. $\frac{14}{3}$. | 24. $\frac{11}{2}$. | 29. $\frac{5}{3}$. | 34. $\frac{9}{5}$. |
| 20. $\frac{12}{9}$. | 25. $\frac{23}{4}$. | 30. $\frac{81}{10}$. | 35. $\frac{125}{100}$. |
| 21. $\frac{14}{6}$. | 26. $\frac{28}{16}$. | 31. $\frac{43}{10}$. | 36. $\frac{15}{7}$. |
| 22. $\frac{11}{3}$. | 27. $\frac{35}{17}$. | 32. $\frac{27}{20}$. | 37. $\frac{16}{9}$. |
| 23. $\frac{12}{11}$. | 28. $\frac{21}{16}$. | 33. $\frac{19}{8}$. | 38. $\frac{25}{12}$. |

85. A mixed number may be expressed as an improper fraction.

EXAMPLE: Express $7\frac{3}{4}$ as an improper fraction.

$$7 \times \frac{4}{4} = \frac{28}{4} \quad \begin{array}{l} 1 \text{ equals } 4 \text{ fourths, therefore } 7 \text{ equals } 7 \times 4 \\ \text{fourths, or } 28 \text{ fourths. } 28 \text{ fourths} + 3 \\ \text{fourths} = 31 \text{ fourths.} \end{array}$$

$$\frac{28}{4} + \frac{3}{4} = \frac{31}{4}.$$

WRITTEN EXERCISES

Express as an improper fraction :

- | | | | | |
|----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| 1. $2\frac{3}{5}$. | 7. $1\frac{1}{4}$. | 13. $3\frac{1}{2}$. | 19. $1\frac{1}{2}$. | 25. $5\frac{3}{8}$. |
| 2. $4\frac{1}{7}$. | 8. $9\frac{3}{4}$. | 14. $6\frac{1}{3}$. | 20. $2\frac{2}{3}$. | 26. $9\frac{1}{4}$. |
| 3. $27\frac{1}{3}$. | 9. $41\frac{1}{4}$. | 15. $12\frac{1}{2}$. | 21. $8\frac{1}{2}$. | 27. $19\frac{3}{4}$. |
| 4. $1\frac{1}{18}$. | 10. $1\frac{7}{20}$. | 16. $2\frac{1}{3}$. | 22. $12\frac{1}{2}$. | 28. $3\frac{1}{8}$. |
| 5. $7\frac{2}{3}$. | 11. $1\frac{5}{18}$. | 17. $5\frac{3}{4}$. | 23. $16\frac{2}{3}$. | 29. $2\frac{1}{17}$. |
| 6. $6\frac{1}{4}$. | 12. $1\frac{4}{13}$. | 18. $7\frac{3}{10}$. | 24. $18\frac{3}{4}$. | 30. $40\frac{1}{2}$. |

COMPARISON

86. PREPARATORY.

1. Which is greater, 7 yd. or 5 yd.?
2. Which is greater, $\frac{7}{8}$ or $\frac{5}{8}$? $\frac{4}{8}$ or $\frac{7}{8}$? $\frac{5}{8}$ or $\frac{7}{8}$?
3. If two unequal fractions have equal denominators, which fraction is the greater?
4. Which fraction is greater, $\frac{1}{4}$ or $\frac{1}{8}$? Why? $\frac{1}{8}$ or $\frac{1}{4}$? Why?
5. Which is less, $\frac{1}{4}$ or $\frac{1}{8}$? Why? $\frac{5}{8}$ or $\frac{7}{8}$? Why?
6. If two unequal fractions have equal numerators, which fraction is the greater?

WRITTEN EXERCISES

Arrange the numbers in each set according to size, placing the least at the top:

1. $\frac{8}{9}$	2. $\frac{10}{4}$	3. $\frac{7}{8}$	4. $\frac{9}{4}$	5. $\frac{7}{8}$
$\frac{8}{12}$	$\frac{10}{2}$	$\frac{7}{6}$	$\frac{9}{6}$	$\frac{8}{8}$
$\frac{8}{9}$	$\frac{10}{10}$	$\frac{7}{2}$	$\frac{9}{18}$	$\frac{5}{8}$
$\frac{8}{8}$	$\frac{10}{18}$	$\frac{7}{9}$	$\frac{9}{20}$	$\frac{11}{8}$
$\frac{8}{7}$	$\frac{10}{11}$	.7	.9	$\frac{8}{8}$

Solve:

6. The areas of Denmark, Venezuela, England, and Germany are respectively $\frac{10}{18}$, $\frac{10}{3}$, $\frac{1}{18}$, and $\frac{10}{6}$ of that of the British Isles. Arrange the names of these countries in order according to their areas.

7. Of all the cotton goods produced in the United States in 1900, about $\frac{1}{3}$ was made in Massachusetts, $\frac{1}{11}$ in South Carolina, $\frac{1}{14}$ in Pennsylvania, $\frac{1}{16}$ in Georgia, $\frac{1}{13}$ in Rhode Island, $\frac{1}{10}$ in Connecticut, $\frac{1}{12}$ in North Carolina, and $\frac{1}{17}$ in New Hampshire. Arrange the names of these states in order according to the amount of cotton goods produced.

8. Of all the boots and shoes made in the United States in 1900, $\frac{1}{10}$ were made in New Hampshire, $\frac{2}{5}$ in Massachusetts, and $\frac{3}{10}$ in New York. Arrange the names of these states in order according to the quantity of boots and shoes manufactured.

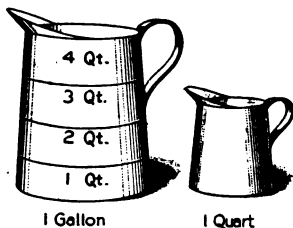
REDUCTION

87. Changing the form of a fraction without changing its value is called **reduction**.

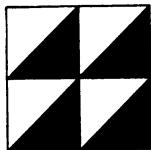
Reduction to Higher or Lower Terms

88. PREPARATORY.

1. How many quarts in a gallon?
2. One quart is what part of a gallon?
3. Two quarts are how many fourths of a gallon?
4. How many quarts in $\frac{1}{2}$ of a gallon?



5. Is there any difference between $\frac{1}{2}$ gallon and $\frac{2}{4}$ gallon?



6. Each triangular tile is what part of this whole square of tiling? Two tiles are how many eighths of the square?

7. How many tiles in $\frac{1}{4}$ of the square?

8. Compare $\frac{1}{4}$ of the square with $\frac{2}{8}$ of it.

9. Similarly, compare $\frac{4}{8}$ of the square with $\frac{2}{4}$ of it. Also with $\frac{1}{2}$ of it.

$$\frac{4}{8} = \frac{2}{4} = \frac{1}{2}.$$

10. If both terms of a fraction are multiplied by two, what is the effect on the value of the fraction? If both terms are divided by 2, what is the effect on the value of the fraction?

89. We have seen (page 61) that a fraction denotes division, and we know that a dividend and its divisor may be divided by the same number without changing the quotient.

Likewise, both dividend and divisor may be multiplied by the same number without changing the quotient. Hence:

90. *Both terms of a fraction may be divided by any number without changing the value of the fraction.*

$$\text{Thus, } \frac{12 \div 6}{18 \div 6} = \frac{2}{3}.$$

91. *Both terms of a fraction may be multiplied by the same number without changing the value of the fraction.*

$$\text{Thus, } \frac{2 \times 6}{5 \times 6} = \frac{12}{30}.$$

ORAL EXERCISES

Reduce these fractions to equal fractions as indicated:

- | | |
|--------------------------------|--------------------------------------|
| 1. $\frac{1}{8}$ to fourths. | 16. $\frac{1}{2}$ to eighths. |
| 2. $\frac{3}{4}$ to thirds. | 17. $\frac{2}{3}$ to twelfths. |
| 3. $\frac{1}{6}$ to fifths. | 18. $\frac{3}{4}$ to eighteenth. |
| 4. $\frac{3}{10}$ to tenths. | 19. $\frac{1}{4}$ to twelfths. |
| 5. $\frac{2}{4}$ to sixths. | 20. $\frac{3}{4}$ to eighths. |
| 6. $\frac{1}{6}$ to halves. | 21. $\frac{3}{4}$ to twentieths. |
| 7. $\frac{2}{7}$ to thirds. | 22. $\frac{2}{3}$ to twentieths. |
| 8. $\frac{1}{2}$ to fourths. | 23. $\frac{2}{3}$ to fifteenths. |
| 9. $\frac{2}{4}$ to sixths. | 24. $\frac{1}{6}$ to twelfths. |
| 10. $\frac{2}{10}$ to tenths. | 25. $\frac{1}{6}$ to twenty-fourths. |
| 11. $\frac{1}{4}$ to sevenths. | 26. $\frac{2}{3}$ to twenty-fifths. |
| 12. $\frac{3}{6}$ to sixths. | 27. $\frac{1}{4}$ to thirty-sixths. |
| 13. $\frac{1}{2}$ to halves. | 28. $\frac{2}{3}$ to forty-ninths. |
| 14. $\frac{1}{10}$ to fifths. | 29. $\frac{2}{3}$ to twenty-firsts. |
| 15. $\frac{1}{4}$ to thirds. | 30. $\frac{1}{6}$ to thirty-seconds. |

31. $\frac{1}{5}$ to fifths.34. $\frac{1}{80}$ to eighty-firsts.32. $\frac{1}{4}$ to fifths.35. $\frac{1}{70}$ to seventy-sevenths.33. $\frac{1}{4}$ to fourths.36. $\frac{1}{90}$ to ninety-sixths.

92. If the terms of a fraction have no common factors except 1, the fraction is said to be in its lowest terms.

93. EXAMPLE: Reduce $\frac{42}{252}$ to lowest terms.

1st Solution:

$$\frac{2)42}{2)252} = \frac{3)21}{3)126} = \frac{7)7}{7)42} = \frac{1}{6}$$

2d Solution:

$$\text{or } \frac{\begin{array}{r} 1 \\ 7 \\ \hline 21 \\ \hline 42 \\ \hline 252 \\ \hline 126 \\ \hline 63 \\ \hline 31.5 \\ \hline 15.75 \\ \hline 7.875 \\ \hline 3.9375 \\ \hline 1.96875 \end{array}}{6} = \frac{1}{6}$$

The form at the left is neater in appearance and shows the steps more plainly.

94. To reduce a fraction to its lowest terms, cancel from the numerator and denominator all common factors.

If the greatest common divisor of the terms is canceled, the fraction is reduced at once to its lowest terms.

WRITTEN EXERCISES

Reduce to lowest terms:

- | | | | | |
|------------------------|-------------------------|--------------------------|--------------------------|--------------------------|
| 1. $\frac{30}{75}$. | 8. $\frac{648}{1944}$. | 15. $\frac{81}{225}$. | 22. $\frac{90}{345}$. | 29. $\frac{28}{552}$. |
| 2. $\frac{64}{216}$. | 9. $\frac{720}{900}$. | 16. $\frac{162}{432}$. | 23. $\frac{24}{600}$. | 30. $\frac{18}{120}$. |
| 3. $\frac{16}{256}$. | 10. $\frac{15}{215}$. | 17. $\frac{175}{4500}$. | 24. $\frac{495}{585}$. | 31. $\frac{16}{256}$. |
| 4. $\frac{54}{702}$. | 11. $\frac{56}{147}$. | 18. $\frac{52}{169}$. | 25. $\frac{324}{2700}$. | 32. $\frac{76}{266}$. |
| 5. $\frac{14}{168}$. | 12. $\frac{44}{198}$. | 19. $\frac{81}{243}$. | 26. $\frac{813}{4065}$. | 33. $\frac{120}{210}$. |
| 6. $\frac{26}{169}$. | 13. $\frac{49}{886}$. | 20. $\frac{315}{869}$. | 27. $\frac{625}{1000}$. | 34. $\frac{225}{2475}$. |
| 7. $\frac{252}{756}$. | 14. $\frac{35}{280}$. | 21. $\frac{35}{210}$. | 28. $\frac{96}{144}$. | 35. $\frac{141}{1269}$. |

Reduction to a Common Denominator

95. EXAMPLES:

1. The market gardeners of New Jersey owned $\frac{3}{5}$ of the farms in that state, and the small farmers $\frac{2}{5}$ of them. What part did they both own?

Add $\frac{3}{5}$ and $\frac{2}{5}$.

Solution: $\frac{3}{5} = \frac{3}{5}$. How is this found?

$$\frac{3}{5} + \frac{2}{5} = \frac{5}{5}.$$

They both owned $\frac{5}{5}$ of the farms.

2. What part of the New Jersey farms were owned by other farmers?

Subtract $\frac{5}{5}$ from 1.

Solution: $1 = \frac{5}{5}$. Why express 1 by $\frac{5}{5}$?

$$\frac{5}{5} - \frac{5}{5} = \frac{0}{5}.$$

Other farmers owned $\frac{0}{5}$ of the farms.

3. One-fifth of a farm was pasture, $\frac{2}{5}$ woodland, $\frac{3}{5}$ meadow, and the rest was planted with crops. What part of the whole farm was planted with crops?

Add $\frac{1}{5}$, $\frac{2}{5}$, and $\frac{3}{5}$.

$$\text{Solution: } \frac{1}{5} = \frac{1}{5} \quad 7$$

$$\frac{2}{5} = \frac{2}{5} \quad 10$$

$$\frac{3}{5} = \frac{3}{5} \quad 6$$

$$23$$

$$\frac{7}{5} + \frac{10}{5} + \frac{6}{5} = \frac{23}{5}.$$

$\frac{23}{5}$ of the whole farm was planted with crops.

Before adding or subtracting the fractions in the above exercises, how were the fractions changed?

96. When two or more fractions have the same denominator, this denominator is called their **common denominator**.

WRITTEN EXERCISES

Change the fractions of each exercise to equal fractions having the common denominator given:

FRACTIONS.	COMMON DENOMINATOR.	FRACTIONS.	COMMON DENOMINATOR.
1. $\frac{5}{16}, \frac{3}{32}$.	64.	4. $\frac{1}{4}, \frac{3}{8}, \frac{7}{2}$.	16.
2. $\frac{1}{8}, \frac{4}{7}, \frac{5}{2}$.	42.	5. $\frac{5}{9}, \frac{6}{8}, \frac{11}{6}$.	18.
3. $\frac{12}{7}, \frac{2}{2}, \frac{1}{4}$.	28.	6. $\frac{3}{6}, \frac{9}{10}, \frac{12}{4}$.	40.

7. From Exercises 1-6 select those exercises in which the new denominator is the least number that could be so used.

8. What is the least common multiple of the denominators given in each exercise?

97. The least common multiple of the given denominators is called the **least common denominator** of the fractions. The abbreviation for least common denominator is l. c. d.

ORAL EXERCISES

Find the least common denominator of:

1. $\frac{2}{3}, \frac{4}{5}$.	6. $\frac{5}{8}, \frac{3}{4}$.	11. $\frac{4}{7}, \frac{3}{6}$.	16. $\frac{5}{6}, \frac{8}{9}$.
2. $\frac{2}{3}, \frac{7}{8}$.	7. $\frac{3}{10}, \frac{7}{8}$.	12. $\frac{7}{9}, \frac{1}{6}$.	17. $\frac{5}{7}, \frac{2}{3}$.
3. $\frac{5}{9}, \frac{7}{12}$.	8. $\frac{3}{8}, \frac{3}{4}$.	13. $\frac{3}{5}, \frac{9}{10}$.	18. $\frac{3}{8}, \frac{5}{24}$.
4. $\frac{5}{9}, \frac{5}{16}$.	9. $\frac{5}{8}, \frac{7}{12}$.	14. $\frac{3}{20}, \frac{7}{10}$.	19. $\frac{1}{4}, \frac{5}{16}$.
5. $\frac{7}{9}, \frac{11}{18}$.	10. $\frac{9}{16}, \frac{7}{8}$.	15. $\frac{4}{6}, \frac{11}{20}$.	20. $\frac{3}{7}, \frac{9}{14}$.

Change to equal fractions with the least common denominator:

21. $\frac{3}{8}, \frac{5}{6}, \frac{1}{4}$.	26. $\frac{3}{8}, \frac{3}{2}, \frac{3}{10}$.	31. $\frac{3}{4}, \frac{2}{3}, \frac{7}{6}$.	36. $\frac{1}{2}, \frac{2}{3}, \frac{5}{6}$.
22. $\frac{3}{2}, \frac{2}{5}, \frac{7}{10}$.	27. $\frac{2}{7}, \frac{1}{4}, \frac{5}{2}$.	32. $\frac{3}{5}, \frac{2}{3}, \frac{1}{15}$.	37. $\frac{1}{2}, \frac{5}{16}, \frac{11}{12}$.
23. $\frac{1}{3}, \frac{5}{6}, \frac{7}{12}$.	28. $\frac{1}{5}, \frac{3}{10}, \frac{7}{20}$.	33. $\frac{1}{4}, \frac{7}{5}, \frac{9}{16}$.	38. $\frac{3}{7}, \frac{9}{14}, \frac{1}{2}$.
24. $\frac{1}{2}, \frac{2}{7}, \frac{3}{14}$.	29. $\frac{1}{2}, \frac{1}{4}, \frac{5}{16}$.	34. $\frac{2}{3}, \frac{5}{6}, \frac{11}{12}$.	39. $\frac{5}{8}, \frac{3}{4}, \frac{9}{16}$.
25. $\frac{3}{4}, \frac{3}{8}, \frac{5}{16}$.	30. $\frac{1}{3}, \frac{1}{6}, \frac{11}{24}$.	35. $\frac{1}{9}, \frac{2}{27}, \frac{1}{3}$.	40. $\frac{1}{5}, \frac{2}{3}, \frac{4}{15}$.

ADDITION AND SUBTRACTION

Addition

98. PREPARATORY.

1. How many are 3 pages and 4 pages? 3 fifths and 4 fifths?

2. What is the sum of 3 qt. and 8 qt.? Of 3 fifths and 8 fifths?

3. Add $\frac{2}{10}$ and $\frac{6}{10}$. Add $\frac{2}{100}$ and $\frac{4}{100}$. Add $\frac{3}{8}$ and $\frac{7}{8}$.

99. *To add fractions with like denominators, add their numerators, place the result over their common denominator, and simplify, if possible.*

ORAL EXERCISES

Add:

$$\begin{array}{r} 1. \frac{11}{4} \\ \frac{15}{4} \\ \hline \frac{8}{4} \end{array}$$

$$\begin{array}{r} 2. \frac{1}{9} \\ \frac{8}{9} \\ \hline \frac{10}{9} \end{array}$$

$$\begin{array}{r} 3. \frac{3}{11} \\ \frac{2}{11} \\ \hline \frac{4}{11} \end{array}$$

$$\begin{array}{r} 4. \frac{5}{12} \\ \frac{11}{12} \\ \hline \frac{7}{12} \end{array}$$

$$\begin{array}{r} 5. \frac{3}{10} \\ \frac{9}{10} \\ \hline \frac{7}{10} \end{array}$$

6. $\frac{3}{7} + \frac{8}{7}$.

8. $\frac{2}{8} + \frac{5}{8}$.

10. $\frac{1}{6} + \frac{4}{6} + \frac{3}{6}$.

7. $\frac{11}{14} + \frac{2}{14}$.

9. $\frac{3}{10} + \frac{4}{10}$.

11. $\frac{1}{6} + \frac{3}{6} + \frac{7}{6}$.

Solve:

12. A man spent $\frac{3}{8}$ of his money for shoes and $\frac{4}{8}$ for books. What part of his money did he spend for both?

13. The height and width of a rectangle are $\frac{4}{5}$ of a ft. and $\frac{3}{5}$ of a ft. What is the distance around the figure?

14. A man set out on a journey; he walked $\frac{1}{10}$ of the way, rode $\frac{2}{10}$ on the electric car, and $\frac{7}{10}$ on the steam railway. What part of his journey had he then traveled?

15. What part of a journey is traveled in an hour and a half by covering $\frac{3}{4}$ of it in the first half hour and $\frac{1}{4}$ in each 20 minutes following?

100. To add fractions with unlike denominators, reduce them to equal fractions having the least common denominator and proceed as with fractions of like denominators.

EXAMPLE: Add $\frac{3}{8}$, $\frac{1}{4}$, $\frac{5}{8}$.

We must first change the fractions to equal fractions with the least common denominator. In this case the least common denominator is 24.

It is convenient in adding several fractions to arrange the work as here shown:

$$\begin{array}{r} \frac{3}{8} = \frac{16}{24} \\ \frac{1}{4} = \frac{6}{24} \\ \frac{5}{8} = \frac{15}{24} \\ \hline \frac{37}{24} \end{array}$$

WRITTEN EXERCISES

Change to equal fractions with least common denominator and add:

- | | | | | | |
|------------------------------------|-------------------------------------|-------------------------------------|--------------------|-------------------|--------------------|
| 1. $\frac{5}{6} + \frac{7}{8}$. | 6. $\frac{8}{9} + \frac{9}{12}$. | 11. $\frac{3}{5} + \frac{5}{12}$. | | | |
| 2. $\frac{1}{6} + \frac{11}{18}$. | 7. $\frac{4}{5} + \frac{9}{20}$. | 12. $\frac{7}{8} + \frac{9}{16}$. | | | |
| 3. $\frac{5}{16} + \frac{5}{8}$. | 8. $\frac{9}{10} + \frac{14}{15}$. | 13. $\frac{8}{9} + \frac{17}{18}$. | | | |
| 4. $\frac{8}{9} + \frac{7}{18}$. | 9. $\frac{7}{9} + \frac{3}{5}$. | 14. $\frac{4}{5} + \frac{9}{10}$. | | | |
| 5. $\frac{5}{7} + \frac{4}{35}$. | 10. $\frac{5}{12} + \frac{5}{18}$. | 15. $\frac{2}{3} + \frac{9}{16}$. | | | |
| 16. $\frac{3}{4}$ | 18. $\frac{8}{9}$ | 20. $\frac{3}{5}$ | 22. $\frac{7}{12}$ | 24. $\frac{5}{6}$ | 26. $\frac{3}{10}$ |
| $\frac{5}{8}$ | $\frac{5}{6}$ | $\frac{11}{10}$ | $\frac{11}{8}$ | $\frac{3}{8}$ | $\frac{4}{5}$ |
| $\frac{1}{6}$ | $\frac{4}{15}$ | $\frac{7}{8}$ | $\frac{2}{3}$ | $\frac{9}{14}$ | $\frac{4}{9}$ |
| <hr/> | <hr/> | <hr/> | <hr/> | <hr/> | <hr/> |
| 17. $\frac{1}{4}$ | 19. $\frac{2}{3}$ | 21. $\frac{4}{9}$ | 23. $\frac{3}{4}$ | 25. $\frac{1}{2}$ | 27. $\frac{5}{9}$ |
| $\frac{2}{5}$ | $\frac{1}{1}$ | $\frac{5}{12}$ | $\frac{13}{10}$ | $\frac{3}{4}$ | $\frac{3}{4}$ |
| $\frac{7}{10}$ | $\frac{5}{6}$ | $\frac{11}{18}$ | $\frac{4}{5}$ | $\frac{7}{8}$ | $\frac{5}{6}$ |
| <hr/> | <hr/> | <hr/> | <hr/> | <hr/> | <hr/> |

Solve:

28. A man sold $\frac{3}{8}$ of an acre at one time, $\frac{1}{2}$ of an acre at another, and $\frac{3}{4}$ at another. How many acres did he sell in all?

29. A farmer plowed $\frac{1}{3}$ of a field one day, $\frac{1}{10}$ of it the next, and $\frac{3}{20}$ of it the next. What part did he plow in the 3 days?

30. If a farmer laid $\frac{1}{3}$ of a mile of drain-tile one year, $\frac{2}{3}$ of a mile the second year, and $\frac{1}{3}$ of a mile the third year, how many miles did he lay in three years?

31. A rectangle is $\frac{1}{4}$ of a foot on one side and $\frac{3}{4}$ of a foot on another. What is the sum of its four sides?

32. Mary used $\frac{3}{4}$ of a yard of string to tie a package and $\frac{2}{16}$ of a yard to fasten on the shipping tag. What part of a yard did she use for both?

33. James had solved $\frac{1}{4}$ of his problems in the afternoon and $\frac{3}{4}$ of them in the evening. What part of the whole number had he solved?

34. A tailor used $\frac{1}{4}$ of a pattern of cloth for a vest and $\frac{3}{4}$ of it for a coat. What part did he use for the coat and vest?

35. A man planted $\frac{3}{8}$ of his farm with corn, $\frac{2}{8}$ of it with potatoes, and $\frac{3}{8}$ with cabbage. What part of his farm did he plant?

36. A broker invested $\frac{3}{8}$ of his money in stocks, $\frac{1}{8}$ in bonds, and $\frac{4}{8}$ in mortgages. What part of his money did he invest in all?

Subtraction

101. PREPARATORY.

1. How many are 12 books less 4 books?
2. How many are 12 sevenths less 4 sevenths?
3. How many are 12 hundredths less 4 hundredths?

102. *To subtract fractions with like denominators, subtract their numerators, place the result over the common denominator, and simplify, if possible.*

ORAL EXERCISES

Subtract:

$$\begin{array}{r} 1. \frac{13}{8} \\ \frac{6}{8} \\ \hline \end{array}$$

$$\begin{array}{r} 2. \frac{12}{15} \\ \frac{7}{15} \\ \hline \end{array}$$

$$\begin{array}{r} 3. \frac{16}{18} \\ \frac{11}{18} \\ \hline \end{array}$$

$$\begin{array}{r} 4. \frac{13}{10} \\ \frac{4}{10} \\ \hline \end{array}$$

$$\begin{array}{r} 5. \frac{26}{100} \\ \frac{16}{100} \\ \hline \end{array}$$

103. To subtract fractions with unlike denominators, reduce them to equal fractions having the least common denominator, and proceed as with fractions having like denominators.

EXAMPLE: If from $\frac{7}{8}$ of a bolt of silk $\frac{3}{4}$ of the whole bolt are sold, what part of the whole bolt remains?

Subtract $\frac{3}{4}$ from $\frac{7}{8}$.

Solution: $\frac{7}{8} = \frac{3\frac{5}{8}}{8}$; $\frac{3}{4} = \frac{2\frac{4}{8}}{8}$.

$\frac{3\frac{5}{8}}{8} - \frac{2\frac{4}{8}}{8} = \frac{1\frac{1}{8}}{8}$, the part of the bolt remaining.

WRITTEN EXERCISES

Reduce to least common denominator and subtract:

$$1. \frac{1\frac{7}{8}}{1\frac{1}{2}}$$

$$2. \frac{1\frac{1}{3}}{1\frac{5}{7}}$$

$$3. \frac{1\frac{6}{25}}{\frac{3}{8}}$$

$$4. \frac{1\frac{1}{8}}{\frac{5}{4}}$$

$$5. \frac{1\frac{5}{16}}{\frac{3}{8}}$$

$$6. \frac{\frac{7}{8}}{\frac{2}{3}}$$

$$7. \frac{9}{10} - \frac{4}{5}.$$

$$12. \frac{1\frac{1}{8}}{1\frac{1}{6}} - \frac{1}{6}.$$

$$17. \frac{7}{8} - \frac{9}{16}.$$

$$22. \frac{1\frac{7}{8}}{1\frac{1}{3}} - \frac{8}{9}.$$

$$8. \frac{5}{8} - \frac{5}{16}.$$

$$13. \frac{1\frac{4}{5}}{1\frac{5}{10}} - \frac{9}{10}.$$

$$18. \frac{7}{9} - \frac{3}{4}.$$

$$23. \frac{7}{10} - \frac{7}{12}.$$

$$9. \frac{4}{5} - \frac{3}{25}.$$

$$14. \frac{5}{12} - \frac{5}{18}.$$

$$19. \frac{2}{3} - \frac{9}{16}.$$

$$24. \frac{1\frac{6}{25}}{2\frac{5}{5}} - \frac{2}{5}.$$

$$10. \frac{1\frac{1}{8}}{1\frac{1}{11}} - \frac{5}{11}.$$

$$15. \frac{1\frac{3}{10}}{1\frac{0}{4}} - \frac{3}{4}.$$

$$20. \frac{7}{10} - \frac{2}{5}.$$

$$25. \frac{5}{7} - \frac{4}{35}.$$

$$11. \frac{1\frac{1}{6}}{1\frac{1}{6}} - \frac{9}{32}.$$

$$16. \frac{2}{1} - \frac{9}{24}.$$

$$21. \frac{1\frac{1}{8}}{1\frac{1}{2}} - \frac{7}{12}.$$

$$26. \frac{3}{4} - \frac{5}{8}.$$

Solve:

27. From a bolt of cloth a merchant sold $\frac{1}{3}$ at one time, $\frac{1}{3}$ at another, and $\frac{1}{4}$ at another. How much did he sell in all?

28. Mary had $\frac{5}{8}$ of a yard of ribbon and used $\frac{5}{24}$ of a yard in tying a package. How much had she left?

29. A tank contained $\frac{7}{8}$ of a gallon of oil, and $\frac{9}{16}$ of a gallon leaked out. How much remained in the tank?

30. A man spent $\frac{1}{4}$ of his salary for rent, $\frac{1}{4}$ for food, $\frac{1}{10}$ for clothing, $\frac{1}{4}$ for other items. What part of his whole salary did he save?

31. A boy spent $\frac{1}{3}$ of his money for books, $\frac{1}{4}$ of it for a cap, and $\frac{1}{10}$ of it for lunch. What part did he spend?

32. Susie had $1\frac{3}{4}$ yd. of cloth to make into a book bag; in cutting it she wasted $\frac{2}{3}$ of a yard. What part of a yard did she use?

33. A man invested $1\frac{1}{2}$ of his money in bonds and $\frac{2}{3}$ in stocks. How much more did he invest in bonds than in stocks?

34. $\frac{1}{2}$ of a farm is meadow land, and $\frac{1}{4}$ is wooded. The meadow land is how much more than the wooded part? The two are what part of the whole farm?

35. Frank spelled $\frac{2}{3}$ of the words in a lesson, and Helen spelled $\frac{1}{3}$ of the words in the same lesson. Who spelled the more words, and what part of the lesson more?

36. Roy gathered $1\frac{1}{2}$ of a bushel of nuts, and Myron gathered $\frac{3}{4}$ of a bushel. Which gathered the more and what part of a bushel more?

Addition and Subtraction of Mixed Numbers

104. EXAMPLES:

1. A boy traveled $1\frac{1}{2}$ hr. by train and $8\frac{3}{4}$ hr. by boat. How many hours did he travel in all?

Solution: $1\frac{1}{2}$ hr. = $1\frac{2}{4}$ hr.

$8\frac{3}{4}$ hr. = $8\frac{3}{4}$ hr.

$\underline{9\frac{5}{4}} \text{ hr.} = 10\frac{1}{4} \text{ hr.}$

2. A chest of tea contains $62\frac{5}{8}$ lb., and $12\frac{1}{4}$ lb. are sold. How many pounds are left?

Solution: $62\frac{5}{8}$ lb. = $62\frac{5}{8}$ lb.

$12\frac{1}{4}$ lb. = $12\frac{2}{8}$ lb.

$\underline{50\frac{3}{8}} \text{ lb.}$

105. In adding or subtracting mixed numbers, perform the operations with the integers and the fractions separately and unite the results.

WRITTEN EXERCISES

Add, and express the sums as mixed or whole numbers :

$$\begin{array}{r} 1. \frac{5}{8} \\ 1\frac{1}{8} \\ \hline \end{array}$$

$$\begin{array}{r} 3. \frac{5}{8} \\ \frac{6}{8} \\ \hline \end{array}$$

$$\begin{array}{r} 5. \frac{7}{10} \\ 1\frac{3}{10} \\ \hline \end{array}$$

$$\begin{array}{r} 7. \frac{5}{13} \\ 1\frac{2}{13} \\ \hline \end{array}$$

$$\begin{array}{r} 2. \frac{3}{4} \\ \frac{6}{4} \\ \hline \end{array}$$

$$\begin{array}{r} 4. \frac{7}{9} \\ \frac{2}{9} \\ \hline \end{array}$$

$$\begin{array}{r} 6. 1\frac{1}{2} \\ 1\frac{1}{2} \\ \hline \end{array}$$

$$\begin{array}{r} 8. 1\frac{3}{8} \\ 2\frac{3}{8} \\ \hline \end{array}$$

Add :

$$\begin{array}{r} 9. 3\frac{3}{4} \\ 5\frac{3}{4} \\ \hline \end{array}$$

$$\begin{array}{r} 12. 6\frac{1}{2} \\ 7\frac{3}{4} \\ \hline \end{array}$$

$$\begin{array}{r} 15. 4\frac{5}{12} \\ 2\frac{1}{2} \\ \hline \end{array}$$

$$\begin{array}{r} 18. 2\frac{1}{8} \\ 5\frac{3}{8} \\ \hline \end{array}$$

$$\begin{array}{r} 21. 4\frac{1}{2} \\ 3\frac{1}{4} \\ \hline \end{array}$$

$$\begin{array}{r} 24. 2\frac{1}{2} \\ 7\frac{3}{4} \\ \hline \end{array}$$

$$\begin{array}{r} 10. 3\frac{1}{2} \\ 2\frac{5}{10} \\ \hline \end{array}$$

$$\begin{array}{r} 13. 1\frac{1}{4} \\ 1\frac{1}{2} \\ \hline \end{array}$$

$$\begin{array}{r} 16. 7\frac{3}{8} \\ 4\frac{1}{12} \\ \hline \end{array}$$

$$\begin{array}{r} 19. 2\frac{3}{8} \\ 6\frac{1}{16} \\ \hline \end{array}$$

$$\begin{array}{r} 22. 6\frac{5}{8} \\ 2\frac{5}{12} \\ \hline \end{array}$$

$$\begin{array}{r} 25. 12\frac{1}{2} \\ 15\frac{3}{4} \\ \hline \end{array}$$

$$\begin{array}{r} 11. 50\frac{3}{4} \\ 17\frac{5}{12} \\ \hline \end{array}$$

$$\begin{array}{r} 14. 63\frac{7}{12} \\ 21\frac{3}{10} \\ \hline \end{array}$$

$$\begin{array}{r} 17. 84\frac{1}{2} \\ 49\frac{9}{16} \\ \hline \end{array}$$

$$\begin{array}{r} 20. 61\frac{5}{8} \\ 27\frac{4}{15} \\ \hline \end{array}$$

$$\begin{array}{r} 23. 7\frac{1}{8} \\ 2\frac{1}{2} \\ \hline \end{array}$$

$$\begin{array}{r} 26. 98\frac{3}{8} \\ 15\frac{1}{2} \\ \hline \end{array}$$

Subtract :

$$\begin{array}{r} 27. 48\frac{3}{4} \\ 14\frac{1}{2} \\ \hline \end{array}$$

$$\begin{array}{r} 29. 53\frac{3}{8} \\ 11\frac{1}{10} \\ \hline \end{array}$$

$$\begin{array}{r} 31. 44\frac{1}{8} \\ 29\frac{3}{4} \\ \hline \end{array}$$

$$\begin{array}{r} 33. 91\frac{1}{2} \\ 47\frac{1}{2} \\ \hline \end{array}$$

$$\begin{array}{r} 35. 34\frac{1}{2} \\ 18\frac{3}{10} \\ \hline \end{array}$$

$$\begin{array}{r} 28. 27\frac{5}{8} \\ 19\frac{7}{16} \\ \hline \end{array}$$

$$\begin{array}{r} 30. 18\frac{7}{12} \\ 10\frac{1}{2} \\ \hline \end{array}$$

$$\begin{array}{r} 32. 40\frac{1}{8} \\ 20\frac{3}{16} \\ \hline \end{array}$$

$$\begin{array}{r} 34. 36\frac{3}{8} \\ 18\frac{3}{8} \\ \hline \end{array}$$

$$\begin{array}{r} 36. 48\frac{1}{2} \\ 27\frac{5}{8} \\ \hline \end{array}$$

Solve :

37. A man walked $11\frac{1}{4}$ mi. on Monday, and $6\frac{7}{12}$ mi. on Tuesday. How many miles did he walk altogether? If his whole journey was $25\frac{1}{2}$ mi., how many miles had he yet to walk?

38. William is $11\frac{3}{4}$ yr. old, and Thomas is $9\frac{5}{12}$ yr. old. William is how much older than Thomas? How many years will have passed before Thomas is 30 yr. old? How old will William be then?

39. A gold dollar contains $23\frac{1}{10}$ grains of gold, and $2\frac{5}{100}$ grains of alloy. What is the weight of the gold dollar?

40. The half-eagle or 5-dollar gold piece contains $99\frac{3}{4}$ more grains of gold than the gold dollar. How much gold does the half-eagle contain?

106. *In subtracting mixed numbers, if the fraction in the minuend is smaller than that in the subtrahend, supply 1 from the integral part.*

EXAMPLES:

1. From a jar containing $18\frac{1}{2}$ lb. of butter, $7\frac{3}{4}$ lb. are sold. How many pounds remain in the jar?

Solution: $18\frac{1}{2}$ lb. = $18\frac{2}{4}$ lb. = $17\frac{4}{4}$ lb.

$$\begin{array}{r} 7\frac{3}{4} \text{ lb.} \\ 17\frac{4}{4} \text{ lb.} \\ \hline 10\frac{1}{4} \text{ lb.} \end{array}$$

2. A park contains 63 acres, of which $13\frac{3}{16}$ acres are given to lakes and lagoons. How many acres are dry land?

$63 \text{ acres} - 62\frac{1}{16} \text{ acres. Why?}$

Solution:

$$\begin{array}{r} 63 = 62\frac{1}{16} \\ 13\frac{3}{16} \quad 13\frac{3}{16} \\ \hline 49\frac{1}{16} \end{array}$$

WRITTEN EXERCISES

Subtract:

$$\begin{array}{r} 1. \quad 16\frac{2}{3} \\ \quad 7\frac{9}{10} \\ \hline \end{array} \quad \begin{array}{r} 4. \quad 9 \\ \quad 5\frac{1}{2} \\ \hline \end{array} \quad \begin{array}{r} 7. \quad 2\frac{3}{4} \\ \quad 1\frac{5}{8} \\ \hline \end{array} \quad \begin{array}{r} 10. \quad 1\frac{1}{2} \\ \quad 1\frac{1}{8} \\ \hline \end{array} \quad \begin{array}{r} 13. \quad 11\frac{3}{4} \\ \quad 9\frac{1}{2} \\ \hline \end{array} \quad \begin{array}{r} 16. \quad 105\frac{3}{8} \\ \quad 89\frac{1}{10} \\ \hline \end{array}$$

$$\begin{array}{r} 2. \quad 12\frac{1}{2} \\ \quad \frac{2}{3} \\ \hline \end{array} \quad \begin{array}{r} 5. \quad 8\frac{1}{4} \\ \quad 4\frac{3}{4} \\ \hline \end{array} \quad \begin{array}{r} 8. \quad 3\frac{3}{4} \\ \quad 1\frac{1}{8} \\ \hline \end{array} \quad \begin{array}{r} 11. \quad 17\frac{1}{4} \\ \quad 1\frac{1}{2} \\ \hline \end{array} \quad \begin{array}{r} 14. \quad 2\frac{1}{2} \\ \quad 2\frac{7}{8} \\ \hline \end{array} \quad \begin{array}{r} 17. \quad 25\frac{3}{4} \\ \quad 2\frac{5}{14} \\ \hline \end{array}$$

$$\begin{array}{r} 3. \quad 6\frac{2}{3} \\ \quad 3\frac{2}{3} \\ \hline \end{array} \quad \begin{array}{r} 6. \quad 16\frac{1}{3} \\ \quad 1\frac{2}{3} \\ \hline \end{array} \quad \begin{array}{r} 9. \quad 6 \\ \quad 2\frac{9}{10} \\ \hline \end{array} \quad \begin{array}{r} 12. \quad 18\frac{1}{2} \\ \quad 8\frac{1}{17} \\ \hline \end{array} \quad \begin{array}{r} 15. \quad 6\frac{1}{2} \\ \quad \frac{1}{2} \\ \hline \end{array} \quad \begin{array}{r} 18. \quad 32\frac{1}{11} \\ \quad 1\frac{5}{8} \\ \hline \end{array}$$

$$19. \quad 16 - 3\frac{5}{8}. \quad 22. \quad 33 - 2\frac{6}{16}. \quad 25. \quad 45 - 1\frac{1}{18}.$$

$$20. \quad 18 - 1\frac{7}{8}. \quad 23. \quad 10 - 4\frac{0}{11}. \quad 26. \quad 63 - \frac{9}{84}.$$

$$21. \quad 26 - 7\frac{5}{8}. \quad 24. \quad 35 - 5\frac{0}{14}. \quad 27. \quad 75 - 4\frac{0}{7}.$$

Solve:

28. Mary bought $12\frac{1}{2}$ yd. of cloth and used $7\frac{3}{8}$ yd. for a dress. How many yards had she left?

29. Charles walks $1\frac{1}{2}$ mi. to school, and George walks $\frac{3}{4}$ of a mile. Who walks the farther, and how much?

30. From a jar containing 20 lb. of butter, a grocer sold $3\frac{1}{4}$ lb. to one customer and $6\frac{5}{8}$ lb. to another. How many pounds are left in the jar?

31. From 20 yd. of cloth a merchant sold $10\frac{3}{4}$ yd., $5\frac{1}{2}$ yd., and $2\frac{3}{8}$ yd. How many yards had he left?

32. There are $20\frac{5}{8}$ lb. of butter in a jar which weighs $4\frac{1}{2}$ lb. What is the combined weight of the butter and the jar?

33. If, from a 5-gallon jug of sirup, $\frac{1}{3}$ is poured out at one time and $\frac{1}{4}$ of the remainder at another, how many gallons remain in the jug?

34. A man bought at different times $20\frac{3}{8}$ acres of land, $50\frac{3}{4}$ acres, and $17\frac{5}{8}$ acres. How many acres did he buy in all?

35. A boy walked $\frac{1}{3}$ of a mile in one day, $\frac{3}{4}$ of a mile the next day, and $1\frac{1}{2}$ mi. the next day. How far did he walk in the three days?

36. A boy took a bicycle trip into the country to visit his uncle. He was gone $6\frac{3}{4}$ hr., $2\frac{5}{8}$ of which he spent with his uncle, and $2\frac{1}{2}$ hr. in riding back. How many hours did he spend in riding out?

37. Mr. Smith's farm contains $102\frac{5}{8}$ acres; Mr. Brown's farm contains $10\frac{1}{4}$ acres more than Mr. Smith's and $26\frac{5}{8}$ less than Mr. Green's farm. How many acres are there in Mr. Brown's farm? In Mr. Green's? In all three together?

38. A school playground was $18\frac{3}{4}$ yd. wide and $27\frac{3}{8}$ yd. long. What was the distance around it?

39. A fishing boat went out from port $10\frac{3}{16}$ mi.; when it had sailed $7\frac{9}{16}$ mi. on its return course it met a squall. How many miles was it then from port?

MULTIPLICATION

Multiplication of a Fraction by an Integer

107. PREPARATORY.

1. 3×2 cents = () cents?

3. $3 \times \frac{2}{5} = \frac{(\quad)}{5}$?

2. 3×2 fifths = () fifths?

4. $3 \times \frac{2}{3} = \frac{(\quad)}{3}$?

108. *To multiply a fraction by an integer, multiply the numerator of the fraction by the integer, and place the result over the denominator.*

EXAMPLE: Find $12 \times \frac{7}{15}$.

$$\text{Solution: } 12 \times \frac{7}{15} = \frac{12 \times 7}{15} = \frac{\overset{4}{\cancel{12}} \times 7}{\underset{5}{\cancel{15}}} = \frac{28}{5} = 5\frac{3}{5}.$$

After indicating the multiplication of the numerator, we reduce the fraction to its lowest terms by dividing both terms by the same number. Thus, 3 divides 12 and 15; hence these are canceled and replaced by the quotients 4 and 5. Then we reduce the result to a mixed number.

In case the denominator of the fraction is divisible by the multiplier, divide the denominator instead of multiplying the numerator.

$$\text{Thus, } 6 \times \frac{5}{18} = \frac{5}{\cancel{18} \div 6} = \frac{5}{3} = 1\frac{2}{3}.$$

ORAL EXERCISES

Find:

1. $6 \times \frac{2}{3}$.

6. $8 \times \frac{3}{4}$.

11. $7 \times \frac{5}{9}$.

16. $5 \times \frac{3}{25}$.

2. $9 \times \frac{5}{18}$.

7. $7 \times \frac{9}{14}$.

12. $3 \times \frac{5}{30}$.

17. $8 \times \frac{7}{16}$.

3. $40 \times \frac{1}{5}$.

8. $25 \times \frac{3}{25}$.

13. $10 \times \frac{2}{30}$.

18. $12 \times \frac{25}{88}$.

4. $15 \times \frac{1}{30}$.

9. $13 \times \frac{5}{26}$.

14. $9 \times \frac{4}{27}$.

19. $16 \times \frac{5}{8}$.

5. $42 \times \frac{3}{7}$.

10. $21 \times \frac{5}{7}$.

15. $64 \times \frac{5}{8}$.

20. $45 \times \frac{7}{15}$.

WRITTEN EXERCISES

Find:

1. $27 \times \frac{15}{9}$.
2. $16 \times \frac{13}{6}$.
3. $56 \times \frac{25}{6}$.
4. $20 \times \frac{63}{5}$.
5. $20 \times \frac{7}{50}$.
6. $18 \times \frac{23}{86}$.
7. $25 \times \frac{38}{100}$.
8. $70 \times \frac{35}{49}$.
9. $80 \times \frac{17}{20}$.
10. $22 \times \frac{85}{44}$.
11. $40 \times \frac{9}{64}$.
12. $25 \times \frac{29}{75}$.
13. $84 \times \frac{5}{12}$.
14. $90 \times \frac{8}{15}$.
15. $84 \times \frac{10}{1728}$.
16. $126 \times \frac{34}{42}$.
17. $36 \times \frac{49}{72}$.
18. $120 \times \frac{11}{12}$.
19. $125 \times \frac{114}{625}$.
20. $243 \times \frac{17}{81}$.

Solve:

21. What floor width can be covered by 8 strips of carpet $\frac{3}{4}$ yd. wide?

22. A fence was built solidly of 184 boards placed vertically, each $\frac{7}{8}$ ft. wide. How long was the fence?

23. If Alice can cut out an apron in $\frac{1}{8}$ of an hour, how long will it take her to cut out a dozen aprons?

24. Express by a fraction the cost of one drum at \$9 per dozen. Find the cost of 20 drums.

Plan: Cost of one drum: $\frac{\$9}{12}$. Cost of 20 drums: $\frac{20 \times \$9}{12} = ()?$

25. Express by a fraction the cost of 1 bracelet at \$11.65 per dozen. Indicate the cost of 16 bracelets. Find the value by canceling.

As above, indicate and find the cost of:

26. 675 dolls at \$26 per gross.
27. 15 doz. candles at \$2 per gross.
28. 20 doz. steel pens at 66¢ per gross.
29. 168 scarf pins at \$9 per hundred.
30. 18 handkerchiefs at \$2 per dozen.
31. 600 drawing pads at \$17 per gross.
32. 32 nickel watches at \$14 per dozen.
33. 21 bottles of ammonia at 88¢ per dozen.
34. 78 toy steam engines at \$65 per hundred.

Multiplication of an Integer by a Fraction**109. PREPARATORY.**

1. What is the cost of $\frac{1}{2}$ of a pound of butter at 20 cts. a pound? What is the cost of 2 lb.?

For $\frac{1}{2}$ lb. the cost is $\frac{1}{2}$ of 20 cts.

For 2 lb., it is 2 times 20 cts.

The words *times* and *of* have been used here with the same meaning.

When the multiplier is a proper fraction, the symbol \times has the same meaning as "of."

Thus, $\frac{2}{3} \times 30$ means $\frac{2}{3}$ of 30.

2. What is the meaning of $\frac{3}{4} \times 16$? $\frac{1}{2} \times 36$? $\frac{2}{3} \times \frac{3}{4}$?

110. *To multiply an integer by a fraction, multiply the integer by the numerator of the fraction and place the result over the denominator.*

EXAMPLE: Find $\frac{3}{4} \times 16$.

Solution: $\frac{3}{4} \times 16 = \frac{3 \times \overset{4}{\cancel{16}}}{\cancel{4}} = 3 \times 4 = 12$.

The work of multiplying an integer by a fraction is exactly the same as that of multiplying a fraction by an integer.

WRITTEN EXERCISES

Find:

1. $\frac{5}{6} \times 420$.

9. $\frac{6}{7} \times 210$.

17. $\frac{8}{9} \times 810$.

2. $\frac{7}{12} \times 42$.

10. $\frac{5}{8} \times 196$.

18. $\frac{4}{5} \times 210$.

3. $\frac{3}{14} \times 729$.

11. $\frac{4}{15} \times 55$.

19. $\frac{9}{10} \times 320$.

4. $\frac{5}{36} \times 840$.

12. $\frac{11}{81} \times 243$.

20. $\frac{9}{42} \times 600$.

5. $\frac{11}{18} \times 360$.

13. $\frac{16}{25} \times 920$.

21. $\frac{8}{15} \times 500$.

6. $\frac{1}{125} \times 1000$.

14. $\frac{1}{128} \times 64$.

22. $\frac{5}{12} \times 1728$.

7. $\frac{3}{25} \times 2240$.

15. $\frac{9}{17} \times 289$.

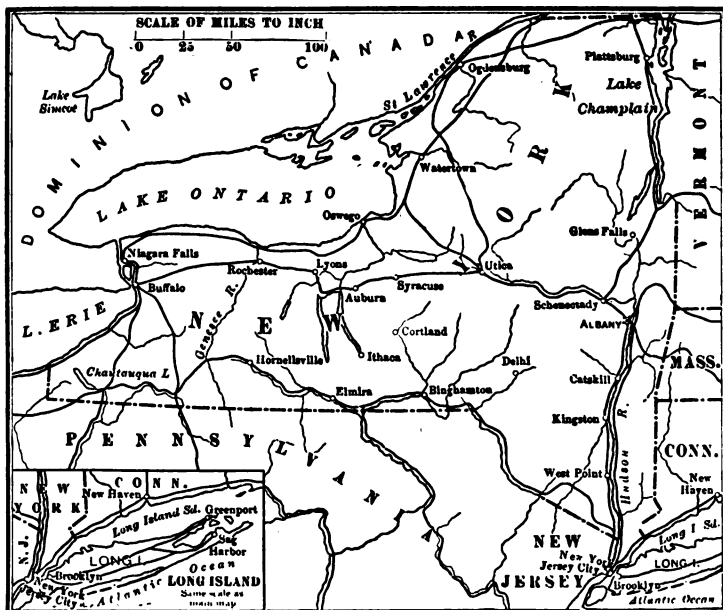
23. $\frac{5}{21} \times 421$.

8. $\frac{8}{45} \times 600$.

16. $\frac{9}{16} \times 1200$.

24. $\frac{5}{64} \times 1024$.

25. According to the scale of miles given on the map, to how many miles does 1 in. on the map correspond? $\frac{1}{2}$ in.? $\frac{1}{4}$ in.? $\frac{1}{8}$ in.? $\frac{1}{10}$ in.?

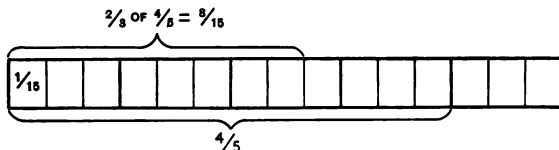


Find the distance within 10 miles :

26. From Buffalo to Albany.
27. From Elmira to Buffalo.
28. From Syracuse to Rochester.
29. From Syracuse to Binghamton.
30. From Albany to New York City.
31. From Binghamton to New York.
32. How many miles apart are two cities that are $1\frac{4}{10}$ in. apart on this map? If possible, find two such cities.
33. Make and solve 3 other problems about the map above.

Multiplication of a Fraction by a Fraction**111. PREPARATORY.**

1. Count the number of small parts into which the figure is divided. Each division is what part of the whole figure?



2. The *heavy* lines divide the figure into how many parts? Each of these is what part of the whole figure?

3. $\frac{1}{3}$ of $\frac{1}{5} = ()$? $\frac{1}{3}$ of $\frac{4}{5} = ()$?

4. Since $\frac{1}{3}$ of $\frac{4}{5} = \frac{4}{3 \times 5}$, what is $\frac{2}{3}$ of $\frac{4}{5}$?

5. In the diagram find $\frac{1}{3}$ of $\frac{1}{5}$. Also $\frac{1}{3}$ of $\frac{4}{5}$. Also $\frac{2}{3}$ of $\frac{4}{5}$.

WRITTEN EXERCISES

Find by diagram :

1. $\frac{3}{5}$ of $\frac{2}{3}$.

3. $\frac{2}{3}$ of $\frac{2}{3}$.

5. $\frac{3}{4}$ of $\frac{3}{4}$.

2. $\frac{2}{5}$ of $\frac{2}{3}$.

4. $\frac{3}{4}$ of $\frac{1}{2}$.

6. $\frac{2}{5}$ of $\frac{3}{4}$.

Find without diagram :

7. $\frac{3}{4}$ of $\frac{5}{8}$.

10. $\frac{2}{3}$ of $\frac{2}{3}$.

13. $\frac{5}{6}$ of $\frac{3}{4}$.

8. $\frac{4}{5}$ of $\frac{2}{3}$.

11. $\frac{4}{5}$ of $\frac{4}{5}$.

14. $\frac{5}{6}$ of $\frac{5}{6}$.

9. $\frac{1}{2}$ of $\frac{7}{8}$.

12. $\frac{3}{8}$ of $\frac{2}{3}$.

15. $\frac{1}{3}$ of $\frac{4}{7}$.

112. The results found in Exercises 1-15 are called the products of the fractions.

113. To find the product of two fractions use the product of their numerators as the numerator of the result and the product of their denominators as the denominator of the result. Simplify this result, if possible.

EXAMPLE: Find $\frac{2}{3}$ of $\frac{3}{4}$, or, find the product of $\frac{2}{3} \times \frac{3}{4}$.

$$\text{Solution: } \frac{\overset{1}{\cancel{2}} \times \overset{1}{\cancel{3}}}{\underset{1}{\cancel{3}} \times \underset{2}{\cancel{4}}} = \frac{1}{2}.$$

The factors common to the terms are canceled as above.

WRITTEN EXERCISES

Find by canceling:

1. $\frac{9}{16}$ of $\frac{10}{11}$.

4. $\frac{8}{33}$ of $\frac{9}{4}$.

7. $\frac{12}{35}$ of $\frac{14}{7}$.

2. $\frac{10}{27}$ of $\frac{15}{7}$.

5. $\frac{28}{5}$ of $\frac{17}{4}$.

8. $\frac{7}{6}$ of $\frac{8}{5}$.

3. $\frac{18 \times 21}{7 \times 9}$.

6. $\frac{3 \times 4 \times 12}{10 \times 48}$.

9. $\frac{68 \times 72 \times 10}{10 \times 32}$.

Solve:

10. A gasoline stove uses $\frac{4}{5}$ of a quart of gasoline per hour. How many quarts does it use in $\frac{3}{5}$ of an hour?

Plan: $\frac{3}{5}$ of $\frac{4}{5}$ qt. = $\frac{3 \times 4}{5 \times 5}$ qt. = () qt.

11. What is the width of the shaded square A? What is its height? Its area? $\frac{1}{5} \times \frac{1}{5} = ()$?

12. What is the width of the rectangle B? Its height? Its area?

$$\frac{2}{5} \times \frac{4}{5} = ()?$$

13. Draw a diagram like this and shade it to show that

$$\frac{3}{5} \times \frac{4}{5} = \frac{12}{25}.$$

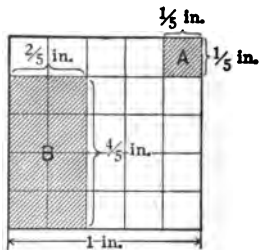
14. Draw another to show that

$$\frac{2}{5} \times \frac{3}{5} = \frac{6}{25}.$$

15. Another to show that

$$\frac{4}{5} \times \frac{2}{5} = \frac{8}{25}.$$

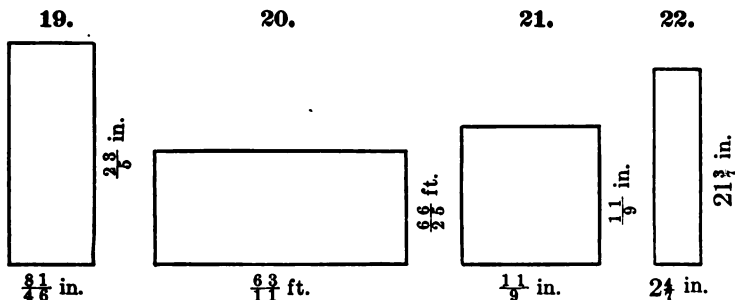
16. A street is $\frac{1}{10}$ of a mile long; $\frac{3}{5}$ of it is paved. What part of a mile is paved? Express the product and cancel the common factors.



17. A cook has $\frac{5}{8}$ of a sack of flour and uses $\frac{3}{8}$ of the flour for a baking. What part does she use? Express the product and cancel the common factors.

18. The length of the Amazon is $3\frac{1}{2}$ times that of the Mississippi, and the length of the Yangtze (China) is $\frac{1}{11}$ of that of the Amazon. The length of the Yangtze is how many times that of the Mississippi?

Find the area of each of these figures :



Multiplication with Mixed Numbers

114. The multiplication of an integer and a mixed number depends upon finding the product of an integer and a fraction.

EXAMPLES:

1. Find $12\frac{3}{4} \times 145$.

$$\begin{array}{r}
 145 \\
 12\frac{3}{4} \\
 \hline
 \frac{3}{4} \times 145 = 87 \\
 2 \times 145 = 290 \\
 10 \times 145 = 145 \\
 \hline
 12\frac{3}{4} \times 145 = 1827.
 \end{array}$$

2. Find $12 \times 145\frac{3}{4}$.

$$\begin{array}{r}
 145\frac{3}{4} \\
 12 \\
 \hline
 12 \times \frac{3}{4} = 7\frac{1}{2} \\
 2 \times 145 = 290 \\
 10 \times 145 = 145 \\
 \hline
 12 \times 145\frac{3}{4} = 1747\frac{1}{2}
 \end{array}$$

The numbers at the left of the equality signs show how the partial products are found.

WRITTEN EXERCISES

Multiply :

1. $196 \times 11\frac{1}{2}$. 5. $156 \times 9\frac{5}{12}$. 9. $86\frac{2}{3} \times 15$. 13. $360 \times 15\frac{1}{2}$.
 2. $120 \times 8\frac{7}{8}$. 6. $64 \times 9\frac{1}{2}$. 10. $12\frac{1}{2} \times 32$. 14. $18 \times 33\frac{1}{2}$.
 3. $200 \times 8\frac{3}{4}$. 7. $40 \times 67\frac{1}{2}$. 11. $50\frac{1}{2} \times 24$. 15. $95 \times 14\frac{1}{2}$.
 4. $160 \times \frac{1}{8}$. 8. $35 \times 25\frac{1}{2}$. 12. $26\frac{2}{10} \times 40$. 16. $144 \times 8\frac{3}{16}$.

Solve :

17. The standard weights of different kinds of fowls are:

KINDS.	WEIGHT.	KINDS.	WEIGHT.
Plymouth Rocks.....	$8\frac{1}{2}$ lb.	Cochins.....	10 lb.
Wyandottes.....	$7\frac{1}{2}$ "	Langshans.....	$8\frac{1}{2}$ "
Light Brahmas.....	$10\frac{1}{2}$ "	Minorcas.....	$7\frac{1}{2}$ "
Dark Brahmas.....	$9\frac{1}{2}$ "	Spanish.....	$7\frac{1}{2}$ "

What is the value of 5 average Plymouth Rocks of the weight given in the table, at 8 cts. a pound?

18. What would be the cost of 15 fowls of each kind given in the table, at 14 cts. a pound?

19. What is the value of a dozen broilers having an average weight of $1\frac{1}{2}$ lb. at 18 cts. a pound?

20. A tailor used $5\frac{1}{2}$ yd. of cloth for a suit. How many yards would he have used for 12 such suits?

21. What is the cost of 25 bu. of wheat at $87\frac{1}{2}$ cts. a bushel?

22. How many miles does a train travel in 14 hr., if its rate is $47\frac{1}{2}$ mi. per hour?

23. 25 adjoining lots are each $4\frac{1}{2}$ rd. long. How long are they together?

24. If, when $18\frac{3}{4}$ mi. of track are laid, $\frac{1}{4}$ of the road is completed, how long is the road?

25. What is the cost of 50 gal. of paint at $66\frac{2}{3}$ cts. a gallon, and $4\frac{1}{2}$ gal. of varnish at \$1.25 a gallon?

115. The product of two mixed numbers may be found in either of two ways.

EXAMPLE: Find $12\frac{2}{3} \times 11\frac{3}{4}$.

1st Solution:

$$12\frac{2}{3} = \frac{38}{3}$$

$$11\frac{3}{4} = \frac{47}{4}$$

$$\frac{\cancel{38}^{19}}{3} \times \frac{\cancel{47}_4^{47}}{2} = \frac{893}{6} = 148\frac{5}{6}$$

2d Solution:

$$\begin{array}{r} 12\frac{2}{3} \\ 11\frac{3}{4} \\ \hline \frac{2}{3} \times \frac{3}{4} = \frac{1}{2} \\ \frac{2}{3} \times 12 = 9 \\ 11 \times \frac{2}{3} = 7\frac{1}{3} \\ 11 \times 12 = 132 \\ \hline 11\frac{3}{4} \times 12\frac{2}{3} = 148\frac{5}{6} \end{array}$$

The first solution includes multiplication of larger numbers, but is simpler.

WRITTEN EXERCISES

Multiply:

1. $3\frac{1}{2} \times 5\frac{1}{2}$

10. $87\frac{1}{2} \times 25\frac{3}{4}$

19. $25\frac{1}{2} \times 3\frac{3}{4}$

2. $12\frac{1}{2} \times 2\frac{3}{4}$

11. $7\frac{3}{8} \times 4\frac{1}{12}$

20. $25\frac{3}{16} \times 48\frac{1}{4}$

3. $32\frac{1}{11} \times 9\frac{1}{2}$

12. $16\frac{2}{3} \times 7\frac{2}{10}$

21. $6\frac{5}{8} \times 2\frac{5}{12}$

4. $31\frac{1}{3} \times 3\frac{1}{2}$

13. $81\frac{9}{10} \times 5\frac{1}{8}$

22. $81\frac{2}{3} \times 21\frac{9}{14}$

5. $26\frac{1}{2} \times 11\frac{1}{2}$

14. $40\frac{3}{4} \times 9\frac{1}{3}$

23. $42\frac{1}{2} \times 13\frac{8}{11}$

6. $23\frac{2}{3} \times 14\frac{1}{3}$

15. $28\frac{1}{2} \times 11\frac{1}{2}$

24. $50\frac{9}{10} \times 25\frac{2}{5}$

7. $16\frac{1}{15} \times 15\frac{2}{3}$

16. $17\frac{1}{2} \times 12\frac{9}{14}$

25. $75\frac{2}{3} \times 10\frac{1}{3}$

8. $6\frac{1}{2} \times 2\frac{1}{12}$

17. $92\frac{5}{8} \times 20\frac{9}{10}$

26. $16\frac{1}{8} \times 12\frac{1}{16}$

9. $18\frac{1}{2} \times 17\frac{1}{2}$

18. $30\frac{1}{2} \times 41\frac{1}{2}$

27. $18\frac{1}{2} \times 20\frac{5}{8}$

Solve:

28. What is the area of a court $8\frac{1}{2}$ yd. long and $12\frac{2}{3}$ yd. wide?

29. What is the area of a floor $15\frac{3}{4}$ ft. long and $12\frac{1}{2}$ ft. wide?

30. How far can a boatman row in $4\frac{1}{12}$ hr. at the rate of $3\frac{1}{2}$ mi. per hour?

31. A reaper harvested $10\frac{1}{2}$ acres per day. How many acres did it harvest in $5\frac{1}{2}$ days?

DIVISION

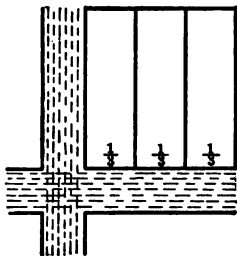
Division of Unity by any Fraction

116. PREPARATORY.

1. A real estate owner divided a plot so that the frontage of each part was $\frac{1}{3}$ of the frontage of the whole. Into how many lots did he divide the plot?

2. How many thirds are there in one whole thing?

3. $1 \div \frac{1}{3} = () ?$



WRITTEN EXERCISES

Show by diagram that :

1. $1 \div \frac{1}{2} = 2$.

3. $1 \div \frac{1}{4} = 4$.

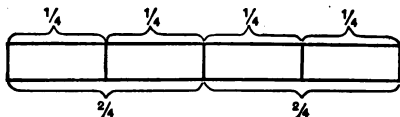
5. $1 \div \frac{1}{5} = 5$.

2. $1 \div \frac{1}{3} = 3$.

4. $1 \div \frac{1}{5} = 5$.

6. $1 \div \frac{1}{8} = 8$.

7. How many times is $\frac{1}{4}$ contained in 1? How many times is $\frac{2}{4}$ contained in 1?



Show from the diagram that $1 \div \frac{2}{4}$ is $\frac{1}{2}$ as many as $1 \div \frac{1}{4}$.

Show by diagram that :

8. $1 \div \frac{2}{3}$ is $\frac{1}{2}$ of $1 \div \frac{1}{3}$.

10. $1 \div \frac{2}{5}$ is $\frac{1}{2}$ of $1 \div \frac{1}{5}$.

9. $1 \div \frac{2}{10}$ is $\frac{1}{2}$ of $1 \div \frac{1}{10}$.

11. $1 \div \frac{3}{8}$ is $\frac{1}{3}$ of $1 \div \frac{1}{8}$.

117. From Exercise 8 we see that $1 \div \frac{2}{3} = \frac{3}{2}$; from Exercise 9, that $1 \div \frac{2}{10} = \frac{10}{2}$; from Exercise 11, that $1 \div \frac{3}{8} = \frac{8}{3}$.

118. The division of 1 by any fraction results in the same fraction inverted.

119. When the terms of a fraction are interchanged, the fraction is said to be *inverted*. Each fraction is called the *reciprocal* of the other.

Thus, $\frac{2}{3}$ becomes $\frac{3}{2}$ when inverted. $\frac{3}{2}$ is the *reciprocal* of $\frac{2}{3}$, and $\frac{2}{3}$ is the *reciprocal* of $\frac{3}{2}$.

ORAL EXERCISES

State the quotients:

1. $1 \div \frac{2}{3}$.

3. $1 \div \frac{3}{4}$.

5. $1 \div \frac{4}{5}$.

7. $1 \div \frac{5}{6}$.

2. $1 \div \frac{3}{5}$.

4. $1 \div \frac{4}{5}$.

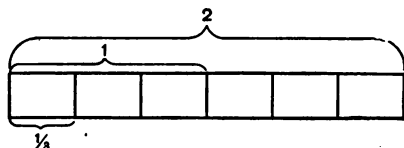
6. $1 \div \frac{5}{6}$.

8. $1 \div \frac{6}{7}$.

Division of any Integer by a Fraction

120. PREPARATORY.

1. Which is the greater, the quotient of $1 \div \frac{1}{3}$ or of $2 \div \frac{1}{3}$? How many times as great? Show this from the diagram.



WRITTEN EXERCISES

Show by diagram that:

1. $3 \div \frac{1}{3}$ is 3 times as great as $1 \div \frac{1}{3}$.

2. $3 \div \frac{1}{4}$ is 3 times as great as $1 \div \frac{1}{4}$.

3. $4 \div \frac{1}{5}$ is 4 times as great as $1 \div \frac{1}{5}$.

4. $6 \div \frac{1}{6}$ is 6 times as great as $1 \div \frac{1}{6}$.

Copy and fill the blanks:

5. $1 \div \frac{2}{3} = (\quad)$.

$3 \div \frac{2}{3} = (\quad)$.

$2 \div \frac{2}{3} = (\quad)$.

6. $1 \div \frac{4}{5} = (\quad)$.

$6 \div \frac{4}{5} = (\quad)$.

$3 \div \frac{4}{5} = (\quad)$.

7. $1 \div \frac{3}{4} = (\quad)$.

$4 \div \frac{3}{4} = (\quad)$.

$2 \div \frac{3}{4} = (\quad)$.

8. $1 \div \frac{5}{6} = (\quad)$.

$8 \div \frac{5}{6} = (\quad)$.

$4 \div \frac{5}{6} = (\quad)$.

9. In Exercise 5, second column, $3 \div \frac{2}{3} = 3 \times \frac{3}{2}$; in Exercise 6, second column, $6 \div \frac{4}{5} = 6 \times \frac{5}{4}$. Write the corresponding relations for Exercises 7 and 8. Note that the divisor is inverted in the result.

10. State how the quotients were found in Exercises 5-8 above.

121. *To divide any integer by a fraction, invert the fraction and multiply.*

WRITTEN EXERCISES

Find the quotients and express them in simplest form:

- | | | | |
|----------------------------|-----------------------------|-------------------------------|-------------------------------|
| 1. $8 \div \frac{5}{4}$. | 5. $9 \div \frac{7}{12}$. | 9. $18 \div \frac{6}{7}$. | 13. $11 \div \frac{2}{3}$. |
| 2. $9 \div \frac{5}{11}$. | 6. $5 \div \frac{6}{7}$. | 10. $7 \div \frac{2}{18}$. | 14. $8 \div \frac{3}{8}$. |
| 3. $3 \div \frac{4}{5}$. | 7. $6 \div \frac{2}{7}$. | 11. $7 \div \frac{4}{5}$. | 15. $7 \div \frac{8}{9}$. |
| 4. $18 \div \frac{5}{8}$. | 8. $90 \div \frac{9}{20}$. | 12. $84 \div \frac{12}{11}$. | 16. $65 \div \frac{13}{15}$. |

Solve:

17. If one garment requires $\frac{3}{4}$ yd. of cloth, how many such garments can be cut from 12 yd.?

18. A real estate owner divided 6 acres of land into lots of $\frac{3}{8}$ of an acre each. How many lots did he have?

19. A bootblack used $\frac{2}{5}$ of a box of blacking to each pair of shoes. How many pairs did he black with 6 boxes?

20. A cook used $\frac{3}{4}$ lb. of sugar for each cake. How many cakes could she make with 10 lb. of sugar?

21. A baker used $\frac{3}{4}$ lb. of flour to a loaf of bread. How many loaves could he make from a barrel (196 lb.) of flour?

Division of a Fraction by a Fraction

122. PREPARATORY.

1. How is 1 divided by $\frac{3}{4}$? $\frac{1}{3}$ divided by $\frac{3}{4}$ would be what part of this?

$$1 \div \frac{3}{4} = 1 \times \frac{4}{3} = \frac{4}{3}.$$

$$\frac{1}{3} \div \frac{3}{4} = \frac{1}{3} \times \frac{4}{3} = \frac{4}{9}.$$

2. $\frac{3}{4}$ divided by $\frac{3}{4}$ is how many times $\frac{1}{3}$ divided by $\frac{3}{4}$?

$$\frac{1}{3} \div \frac{3}{4} = \frac{1}{3} \times \frac{4}{3} = \frac{4}{9}.$$

$$\frac{3}{4} \div \frac{3}{4} = \frac{3}{4} \times \frac{4}{3} = 1.$$

123. *To divide a fraction by a fraction, invert the divisor and multiply.*

WRITTEN EXERCISES

Find the quotients, simplifying, when necessary, by canceling:

- | | | | |
|--------------------------------------|--------------------------------------|--|--|
| 1. $\frac{2}{3} \div \frac{3}{4}$. | 5. $\frac{5}{6} \div \frac{7}{8}$. | 9. $\frac{5}{8} \div \frac{2}{3}$. | 13. $\frac{5}{8} \div \frac{9}{16}$. |
| 2. $\frac{6}{11} \div \frac{4}{5}$. | 6. $\frac{4}{5} \div \frac{7}{9}$. | 10. $\frac{3}{8} \div \frac{11}{12}$. | 14. $\frac{7}{18} \div \frac{14}{15}$. |
| 3. $\frac{3}{7} \div \frac{3}{4}$. | 7. $\frac{4}{5} \div \frac{9}{20}$. | 11. $\frac{11}{12} \div \frac{5}{8}$. | 15. $\frac{11}{32} \div \frac{22}{25}$. |
| 4. $\frac{6}{13} \div \frac{5}{6}$. | 8. $\frac{5}{16} \div \frac{8}{9}$. | 12. $\frac{7}{18} \div \frac{7}{12}$. | 16. $\frac{8}{16} \div \frac{7}{22}$. |

Division of a Fraction by an Integer

124. An integer may be written in fractional form by using 1 for the denominator.

Thus, $8 = \frac{8}{1}$.

To divide a fraction by an integer, supply the denominator 1 and proceed as in dividing a fraction by a fraction.

Thus, $\frac{5}{7} \div 10 = \frac{5}{7} \div \frac{10}{1} = \frac{5}{7} \times \frac{1}{10} = \frac{1}{14}$.

WRITTEN EXERCISES

Divide:

- | | | | |
|-------------------------------|------------------------------|------------------------------|------------------------------|
| 1. $\frac{8}{9} \div 18$. | 4. $\frac{17}{24} \div 34$. | 7. $\frac{16}{25} \div 48$. | 10. $\frac{9}{32} \div 27$. |
| 2. $\frac{9}{40} \div 36$. | 5. $\frac{13}{20} \div 26$. | 8. $\frac{17}{25} \div 34$. | 11. $\frac{18}{25} \div 9$. |
| 3. $\frac{11}{12} \div 121$. | 6. $\frac{7}{16} \div 245$. | 9. $\frac{5}{12} \div 50$. | 12. $\frac{9}{32} \div 81$. |

Solve:

13. A repeating gun fired 7 shots in $\frac{1}{10}$ of a minute. What part of a minute was this per shot?

14. A man laid 125 shingles in $\frac{1}{6}$ of an hour. What part of a minute did it take per shingle?

15. A pump drew $\frac{3}{8}$ of a barrel of water in 45 seconds. How much did it draw in 1 second?

16. A boy ran $\frac{3}{8}$ of a mile in 7 minutes. How far did he run in 1 minute?

Division with Mixed Numbers

125. To divide with mixed numbers, first reduce the mixed numbers to improper fractions, then invert the divisor, and multiply.

EXAMPLE: Divide $4\frac{1}{2}$ by $3\frac{7}{8}$.

$$\text{Solution: } 4\frac{1}{2} = \frac{37}{8}.$$

$$3\frac{7}{8} = \frac{55}{8}.$$

$$4\frac{1}{2} \div 3\frac{7}{8} = \frac{37}{8} \div \frac{55}{8} = \frac{37}{8} \times \frac{8}{55} = \frac{37}{55} = 1\frac{2}{55}.$$

$$\text{Test: } \frac{74}{55} \times \frac{55}{16} = \frac{74}{16} = 4\frac{1}{2}.$$

WRITTEN EXERCISES

Divide and test:

1. $1\frac{1}{2} \div \frac{1}{4}.$

5. $2\frac{1}{2} \div \frac{1}{4}.$

9. $6\frac{3}{4} \div 3\frac{3}{4}.$

2. $2\frac{1}{2} \div 1\frac{1}{2}.$

6. $\frac{3}{4} \div 4\frac{1}{2}.$

10. $16\frac{1}{2} \div 3\frac{1}{2}.$

3. $5\frac{1}{2} \div 2\frac{1}{4}.$

7. $7\frac{3}{8} \div 2\frac{1}{4}.$

11. $11\frac{1}{2} \div 3\frac{3}{4}.$

4. $3\frac{3}{8} \div 7\frac{1}{4}.$

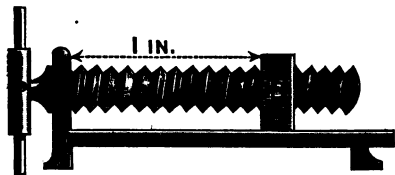
8. $6\frac{3}{4} \div 8\frac{3}{4}.$

12. $4\frac{3}{4} \div 17\frac{1}{2}.$

Solve:

13. How many garments requiring $\frac{1}{2}$ of a yard of cloth can be cut from $4\frac{1}{2}$ yd.?

14. How many packages of $3\frac{3}{4}$ lb. each can be made from $6\frac{1}{2}$ lb. of pepper?



15. How many threads are there in 1 inch of this screw?

When the screw is turned around once, how far is the block, B, moved? How many turns must the screw make to move B $\frac{1}{2}$ in.? $1\frac{1}{2}$ in.? $\frac{1}{4}$ in.? $1\frac{1}{4}$ in.?

16. A roll of tape contains $13\frac{1}{2}$ yd. How many pieces of $4\frac{1}{2}$ yd. each can be cut from it?

17. How many sections of $5\frac{1}{2}$ ft. each in a walk $46\frac{3}{4}$ ft. long?

To Find What Part One Number Is of Another

126. A fraction expresses what part the numerator is of the denominator.

Thus, $\frac{3}{4}$ indicates that 3 is $\frac{3}{4}$ of 4. Similarly, $\frac{8}{16}$ indicates that 8 is $\frac{8}{16}$ of 16, or $\frac{1}{2}$ of 16.

127. *To find what part one number is of another, make the first number the numerator of a fraction, the second number the denominator, and reduce the fraction to lowest terms.*

EXAMPLE: 36 is what part of 144?

$$\text{Solution: } \frac{\overset{1}{\cancel{36}}}{\underset{4}{\cancel{144}}} = \frac{1}{4}.$$

ORAL EXERCISES

1. 8 is what part of 32? Of 80? 64? 48? 72? 40? 80?
2. 9 is what part of 27? Of 45? 90? 63? 36? 72?
3. 12 is what part of 24? Of 18? 60? 36? 42? 72?

WRITTEN EXERCISES

1. 72 is what part of 144?
2. 96 is what part of 256? Of 800? Of 1,728?
3. 27 is what part of 243? Of 900? Of 1,728?
4. 15 is what part of 225? Of 400? Of 915? Of 105?
5. 18 rd. are what part of a mile?
6. 450 lb. are what part of a ton?
7. 81 cu. in. are what part of a cubic foot?
8. An investor had \$650 and bought stocks with \$350. What part of his money did he use?
9. There are 1,760 yd. in a mile; a balloonist was 800 yd. high. What part of a mile was he from the ground?
10. A depositor had \$1,575 in the bank and drew \$500. What part remained in the bank?

To Find the Whole When a Fractional Part Is Given**128. PREPARATORY.**

1. If $\frac{1}{3}$ of my money is 3 cts., how many cents have I?
2. If $\frac{1}{4}$ of a class is 8 pupils, how many are in the class?
3. $\frac{3}{4}$ of the number of cubic feet in a yard is 24. How many cubic feet in a yard?

129. *To find the whole when a fractional part is given, divide the given part by the numerator of the given fraction and multiply the result by the denominator.*

EXAMPLE: $\frac{7}{15}$ of a number is 28. What is the number?

Solution: $\frac{7}{15}$ of the number is 28.

$\frac{1}{15}$ of the number = $\frac{1}{7}$ of 28, or 4.

The whole number, or $\frac{15}{1}$, = $4 \times 15 = 60$.

Or, the problem may be indicated and worked as follows:

$$28 \div \frac{7}{15} = \frac{28}{1} \times \frac{15}{7} = \frac{60}{1} = 60.$$

WRITTEN EXERCISES

1. $\frac{3}{4}$ of a farm contained 225 acres. How many acres in the whole farm?
2. $\frac{3}{10}$ of a mile is 528 yd. How many yards in a mile?
3. $\frac{11}{11}$ of the distance from New York City to Albany is 22 mi. What is the whole distance?
4. 120 bu. in a carload of fruit spoiled in transit. This was $\frac{2}{3}$ of the carload. How many bushels were there in all?
5. A man invested \$8,559, or $\frac{9}{16}$ of his money. How much was he worth?
6. The dues paid by the members of a club are \$2,500 a year; this is $\frac{5}{8}$ of the whole expenses of the club. What are the whole expenses?

Complex Fractions

130. The division of one fraction by another may be indicated in fractional form.

Thus, $\frac{2}{3} \div \frac{1}{4}$ may be written $\frac{\frac{2}{3}}{\frac{1}{4}}$, and $4 \div 5\frac{1}{2}$ may be written $\frac{4}{5\frac{1}{2}}$.

131. When either one or both of the terms of a fraction contain a fraction, the expression is called a **complex fraction**.

Thus, $\frac{\frac{1}{2}}{\frac{3}{4}}$, $\frac{7\frac{1}{2}}{9}$, and $\frac{8}{16\frac{1}{2}}$ are complex fractions.

132. To simplify a complex fraction, divide the numerator by the denominator.

EXAMPLES:

1. Simplify $\frac{\frac{5}{8}}{\frac{3}{4}}$.

The fraction $= \frac{5}{8} \div \frac{3}{4} = \frac{5}{8} \times \frac{4}{3} = \frac{5}{6}$.

2. Simplify $\frac{8}{16\frac{1}{2}}$.

The fraction $= 8 \div 16\frac{1}{2} = 8 \times \frac{2}{33} = \frac{8}{33}$.

3. Simplify $\frac{3\frac{1}{2} \times 15}{25 \times 7\frac{1}{2}}$.

The fraction $= \frac{\frac{7}{2} \times 3}{5 \times 6\frac{1}{2}} = \frac{21}{2} \div \frac{245}{8} = \frac{21}{2} \times \frac{8}{245} = \frac{84}{245}$.

WRITTEN EXERCISES

Simplify:

1. $\frac{\frac{4}{5}}{\frac{2}{3}}$.

2. $\frac{\frac{6}{7}}{\frac{3}{14}}$.

3. $\frac{12}{9\frac{1}{2}}$.

4. $\frac{7\frac{1}{2}}{20\frac{3}{4}}$.

5. $\frac{3\frac{1}{2} \times 8 \times 7\frac{3}{4}}{12\frac{1}{2} \times 16 \times \frac{1}{2}}$.

7. $\frac{80 \times 16\frac{1}{2}}{\frac{3}{25} \times 16}$.

6. $\frac{12 \times 14\frac{3}{4}}{90 \times 24\frac{1}{2}}$.

8. $\frac{15\frac{1}{2} \times 25\frac{3}{10}}{7\frac{1}{2} \times 12\frac{9}{10}}$.

REVIEW

ORAL EXERCISES

1. What is a mixed number? How is a mixed number related to an improper fraction? Illustrate.
2. How is one fraction divided by another? Illustrate by $\frac{3}{4} \div \frac{1}{2}$.
3. What change should be made in fractions with different denominators before adding or subtracting? Illustrate.
4. Write a mixed number. Explain how to change it to an improper fraction.
5. Illustrate what is meant by reducing a fraction to its lowest terms.
6. How may subtraction of fractions be tested?
7. If two fractions have equal denominators and unequal numerators, which fraction is the larger?
8. If two fractions have equal numerators and unequal denominators, which fraction is the larger?
9. If the numerator of a fraction is multiplied by a certain number, how is the value of the fraction changed?
10. What is the effect on the value of a fraction, if both numerator and denominator are multiplied or divided by the same number?
11. The value of a fraction may be divided by a number by dividing the numerator by that number. Explain why this is true.
12. The value of a fraction may be divided by a number by multiplying the denominator by that number. Explain why this is true.
13. How is the product of an integer and a fraction found?
14. How is the product of two fractions found?
15. How do we divide any number by a fraction?

16. How is the division of fractions tested?

17. What two ways are there of multiplying mixed numbers?

18. Add at sight by giving the sum after the 2d, 3d, 4th addend, and so on to the end: $2\frac{1}{2} + 2\frac{1}{2} + 2\frac{1}{2} + 2\frac{1}{2} + 2\frac{1}{2} + 2\frac{1}{2} + 2\frac{1}{2} + 2\frac{1}{2}$.

19. Add as in Exercise 18 by repeating $3\frac{1}{2}$ until the sum is 30.

Add by repeating each of the following until the sum equals or exceeds 100 :

20. $3\frac{1}{4}$. 21. $12\frac{1}{4}$. 22. $6\frac{1}{4}$. 23. $33\frac{1}{4}$. 24. $16\frac{3}{4}$.

25. In one week a man worked $\frac{1}{2}$ da., $\frac{2}{3}$ da., and $\frac{3}{4}$ da. How many days did he work in all?

WRITTEN EXERCISES

Reduce to lowest terms :

- | | | | | |
|-----------------------|------------------------|------------------------|------------------------|-------------------------|
| 1. $\frac{40}{60}$. | 5. $\frac{15}{25}$. | 9. $\frac{89}{100}$. | 13. $\frac{72}{144}$. | 17. $\frac{121}{220}$. |
| 2. $\frac{17}{85}$. | 6. $\frac{25}{95}$. | 10. $\frac{16}{84}$. | 14. $\frac{36}{96}$. | 18. $\frac{22}{121}$. |
| 3. $\frac{35}{105}$. | 7. $\frac{88}{1381}$. | 11. $\frac{69}{126}$. | 15. $\frac{12}{20}$. | 19. $\frac{30}{225}$. |
| 4. $\frac{96}{144}$. | 8. $\frac{75}{250}$. | 12. $\frac{95}{210}$. | 16. $\frac{34}{51}$. | 20. $\frac{12}{108}$. |

Add :

- | | | |
|---|--|---|
| 21. $\frac{1}{6} + \frac{5}{24} + \frac{3}{8}$. | 27. $\frac{2}{8} + \frac{7}{18} + \frac{4}{9}$. | 33. $\frac{1}{2} + \frac{3}{16} + \frac{7}{18}$. |
| 22. $\frac{1}{12} + \frac{8}{32} + \frac{1}{6}$. | 28. $\frac{3}{14} + \frac{5}{21} + \frac{5}{7}$. | 34. $\frac{3}{15} + \frac{7}{10} + \frac{1}{12}$. |
| 23. $\frac{4}{5} + \frac{7}{15} + \frac{8}{9}$. | 29. $\frac{40}{61} + \frac{8}{7} + \frac{1}{2}$. | 35. $\frac{9}{16} + \frac{8}{25} + \frac{3}{8}$. |
| 24. $\frac{7}{16} + \frac{9}{24} + \frac{11}{12}$. | 30. $\frac{13}{38} + \frac{8}{9} + \frac{2}{3}$. | 36. $\frac{12}{25} + \frac{7}{15} + \frac{1}{30}$. |
| 25. $\frac{8}{17} + \frac{3}{24} + \frac{10}{51}$. | 31. $\frac{21}{39} + \frac{4}{65} + \frac{4}{5}$. | 37. $\frac{41}{100} + \frac{4}{25} + \frac{5}{6}$. |
| 26. $40\frac{3}{4} + 120\frac{3}{4}$. | 32. $32\frac{1}{16} + 68\frac{3}{8}$. | 38. $25\frac{1}{4} + 150\frac{3}{16}$. |

Subtract :

- | | | |
|-------------------------------------|--------------------------------------|---------------------------------------|
| 39. $\frac{9}{10} - \frac{2}{15}$. | 41. $\frac{25}{2} - \frac{1}{3}$. | 43. $90\frac{1}{4} - 37\frac{1}{2}$. |
| 40. $\frac{12}{9} - \frac{2}{11}$. | 42. $\frac{15}{39} - \frac{5}{13}$. | 44. $\frac{211}{20} - 4\frac{2}{5}$. |

45. $\frac{7}{8} - \frac{3}{14}$.

47. $100\frac{7}{12} - 56\frac{1}{2}$.

49. $\frac{59}{81} - \frac{3}{27}$.

46. $\frac{11}{18} - \frac{3}{36}$.

48. $\frac{11}{8} - \frac{5}{24}$.

50. $\frac{71}{33} - \frac{5}{11}$.

Multiply :

51. $\frac{7}{16}$ by 8.

53. $\frac{1}{2}$ by 25.

55. $\frac{1}{2}$ by 14.

52. $\frac{1}{2}$ by 100.

54. $\frac{7}{9}$ by 35.

56. $\frac{4}{9}$ by 36.

57. Multiply by $\frac{5}{8}$ the following: $\frac{3}{4}$; $\frac{3}{8}$; $\frac{2}{3}$; $\frac{4}{5}$; $\frac{5}{6}$; $\frac{7}{8}$; $\frac{3}{8}$.

58. Multiply by $\frac{3}{7}$ the following: $\frac{3}{8}$; $\frac{3}{4}$; $\frac{2}{3}$; $\frac{3}{8}$; $\frac{7}{8}$; $\frac{4}{5}$; $\frac{7}{8}$.

Divide :

59. $\frac{9}{10} \div 90$.

64. $\frac{1}{4} \div 14$.

69. $\frac{9}{16} \div 81$.

60. $\frac{1}{2} \div 34$.

65. $\frac{1}{8} \div 51$.

70. $\frac{3}{2} \div 78$.

61. $100 \div \frac{3}{4}$.

66. $900 \div \frac{3}{8}$.

71. $144 \div \frac{9}{16}$.

62. $75 \div \frac{3}{8}$.

67. $25 \div \frac{3}{8}$.

72. $320 \div \frac{1}{20}$.

63. $\frac{7}{8} \div \frac{9}{16}$.

68. $\frac{5}{16} \div \frac{3}{32}$.

73. $\frac{21}{56} \div \frac{2}{16}$.

74. 16 is what part of 96? of 144? of 256?

75. 48 is what part of 196? of 144? of 320?

76. 32 is $\frac{7}{8}$ of a certain number. What is the number?

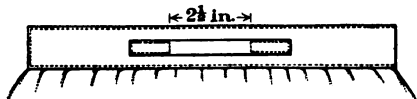
77. 63 is $\frac{5}{8}$ of a certain number. What is the number?

78. Simplify $\frac{3\frac{1}{2} \times 4\frac{2}{3}}{5\frac{1}{4} \times 15 \times 120}$.

79. Also $\frac{16\frac{2}{3} \times 10\frac{2}{3}}{24\frac{2}{3} \times 20\frac{3}{10}}$.

Solve :

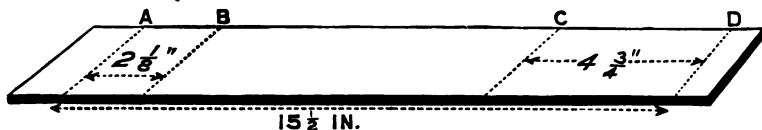
80. A breadth of canvas is $22\frac{3}{4}$ in. wide after a hem of $\frac{5}{8}$ in. has been made along each edge. How wide was the canvas before the hems were turned?



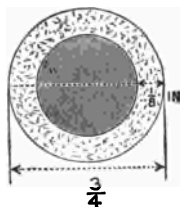
81. A tape loop sewed to a band has a free length of $2\frac{1}{4}$ in. as shown in the picture. If $\frac{3}{4}$ in. is turned under at each end, and the tape is stitched down $1\frac{1}{4}$ in. from each end, how long was the piece of tape?

82. Four half-inch holes are bored at equal intervals in a towel-rack. The distance from each hole to the next one is 4 in., and the outer ones are $1\frac{1}{2}$ in. from the ends of the rack. What is the length of the rack?

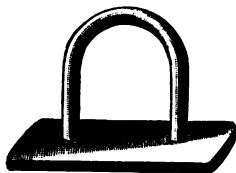
83. Distances in inches are laid off on an iron band as shown in the figure. Find the distance from B to C.



84. The outer diameter of this flat ring and its width are shown. What is the diameter of the circle cut from the center?



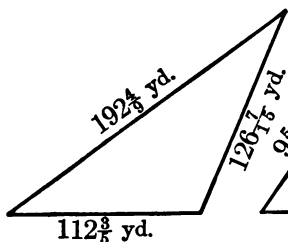
85. The picture shows an iron staple set in a piece of iron $\frac{1}{8}$ in. thick. The length of the staple from one end to the other above the plate is $3\frac{1}{4}$ in. Before it was riveted it projected through the plate $\frac{1}{8}$ in. at each end. How long must the piece of rod be cut to make one staple?



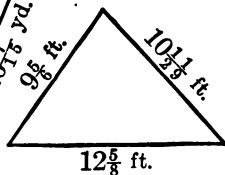
86. A piece of woolen was $78\frac{1}{2}$ yd. long; after washing it was $69\frac{5}{16}$ yd. long. How many yards did it shrink?

Find the length of fence around each of the following fields:

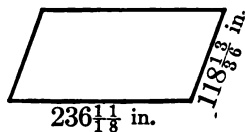
87.



88.



89.



90. A rectangular garden is $21\frac{1}{2}$ ft. wide and $2\frac{1}{2}$ times as long. How long a fence will be required to enclose it?

91. A bicycle rider goes $\frac{1}{4}$ mi. in the first minute of a race, $\frac{3}{8}$ of a mile in the second minute, and $\frac{7}{16}$ of a mile in the third. How far does he ride altogether?

92. Mr. Smith burned $\frac{1}{4}$ of a ton of coal in his furnace in October, $\frac{1}{3}$ of a ton in November, $1\frac{1}{3}$ tons in December, $2\frac{1}{2}$ tons in January, $1\frac{1}{2}$ tons in February, $1\frac{1}{2}$ tons in March, $1\frac{1}{8}$ tons in April, and $\frac{3}{16}$ of a ton in May. How many tons of coal did he use altogether?

93. A farmer planted $63\frac{1}{2}$ acres of his farm in wheat, $16\frac{1}{2}$ acres in oats, $46\frac{1}{2}$ acres in corn, and as much as $\frac{1}{3}$ of the sum of these in rye. How many acres did he plant?

94. How many feet of iron rod are needed to make 2 dozen wire staples, requiring $2\frac{1}{2}$ in. each?

95. A man sold $579\frac{1}{2}$ lb. of butter, of which $85\frac{1}{2}$ lb. were in one tub, $250\frac{3}{4}$ lb. in another, and $143\frac{1}{2}$ lb. in another. The rest was in the fourth tub. How many pounds was this?

96. A grocer had 558 bu. of apples and sold $\frac{4}{5}$ of them. How many bushels had he left?

97. From a pile of potatoes containing 413 bu., $57\frac{1}{2}$ bu. were taken away. What fraction of the whole was taken away?

98. A bicyclist traveled $45\frac{3}{16}$ mi. one day, $56\frac{1}{2}$ mi. the next, $35\frac{1}{2}$ mi. the third, and $55\frac{1}{16}$ mi. the fourth. How far did he travel in the four days?

99. $\frac{2}{3}$ of the value of a house was \$826. What was the whole value of the house?

100. A merchant had 95 yd. of cloth, and sold $\frac{1}{4}$ of it to one customer, $\frac{1}{3}$ of the remainder to another, then $\frac{1}{3}$ of what was left to another. How many yards had he left?

101. A man earns \$215 per month; he spends $\$36\frac{1}{2}$ for rent, and $1\frac{1}{2}$ times as much for his other living expenses. How much has he left?

CHAPTER III

DECIMAL FRACTIONS

NOTATION AND NUMERATION

Tenths and Hundredths

133. PREPARATORY.

1. In the number \$3.56 there are how many whole dollars? How many dimes, or *tenths* of a dollar? How many cents, or *hundredths* of a dollar?

2. Name the figure in tenths' place in the above number. Also the figure in hundredths' place.

3. Read the following numbers: 3.5 ft.; 6.25 ft.; .9 gal.; .09 mi.; .18 yd.

4. How many decimal places must be used to express completely a number of hundredths?

134. The place at the right of the decimal point, next to units' place, is called **tenths'** place.

The next place at the right is called **hundredths'** place.

135. Zeros annexed at the right of a decimal do not change its value. For, since $\frac{3}{10} = \frac{30}{100}$, then $.3 = .30$.

136. Numbers expressed in decimal form are said to be **written decimally**.

ORAL EXERCISES

Read :

1. 10.3 dollars; 10.3 quarts; 10.3 yards.

2. 6.8; 8.8; 5.8; 105.6; 55.5; .9.

3. 2.05 dollars; 2.05 feet; 2.05 ounces.
4. .99 of a dollar; .99 of a quart; .99 of a year.
5. 3.25; 8.90; 7.08; .63; 73.40; 17,289.12.
6. Express as tenths: .50; .20; 4.70; .90.
7. Express as hundredths: .350; .750; .100; .050; 9.6.

WRITTEN EXERCISES*Write decimally:*

- | | | | | |
|------------------------------|-------------------------------|----------------------|------------------------|-------------------------|
| 1. Seven tenths. | 7. Twenty and two tenths. | | | |
| 2. Nineteen and nine tenths. | 8. Twenty-two and two tenths. | | | |
| 3. Eleven hundredths. | 9. Five hundredths. | | | |
| 4. 35 hundredths. | 10. Ninety-nine hundredths. | | | |
| 5. 12 and 39 hundredths. | 11. 40 hundredths. | | | |
| 6. 1 and 1 hundredth. | 12. 5 and 5 hundredths. | | | |
| 13. $\frac{3}{10}$. | 17. $\frac{11}{10}$. | 21. $\frac{9}{10}$. | 25. $\frac{3}{100}$. | 29. $\frac{9}{100}$. |
| 14. $\frac{5}{10}$. | 18. $\frac{45}{10}$. | 22. $\frac{8}{10}$. | 26. $\frac{25}{100}$. | 30. $\frac{5}{100}$. |
| 15. $\frac{14}{10}$. | 19. $\frac{1}{10}$. | 23. $\frac{7}{10}$. | 27. $\frac{55}{100}$. | 31. $\frac{15}{100}$. |
| 16. $\frac{32}{10}$. | 20. $\frac{6}{10}$. | 24. $\frac{4}{10}$. | 28. $\frac{10}{100}$. | 32. $\frac{175}{100}$. |

Write in words:

- | | | | |
|-----------|------------|-----------|------------|
| 33. 21.3. | 37. 11.1. | 41. 55.5. | 45. 33.3. |
| 34. 26.6. | 38. 41.1. | 42. 37.2. | 46. 99.9. |
| 35. .15. | 39. 1.09. | 43. .25. | 47. 10.08. |
| 36. .99. | 40. 86.06. | 44. .09. | 48. 35.35. |

Write in the form of a common fraction:

- | | | | |
|-----------|-----------|------------|------------|
| 49. .3. | 55. 7.1. | 61. 23.4. | 67. 3.6. |
| 50. 1.5. | 56. .1. | 62. 11.1. | 68. 20.3. |
| 51. .15. | 57. 1.09. | 63. 10.08. | 69. .05. |
| 52. .09. | 58. .99. | 64. 1.75. | 70. 56.25. |
| 53. 1.25. | 59. 1.01. | 65. .29. | 71. 5.75. |
| 54. .86. | 60. .45. | 66. 1.17. | 72. 2.90. |

Thousandths**137. PREPARATORY.**

1. How many blocks like Figure 1 does Figure 2 contain? How many blocks like Figure 2 does Figure 3 contain?



Figure 1.



Figure 2.

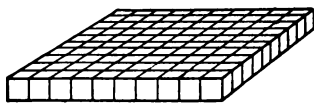


Figure 3.

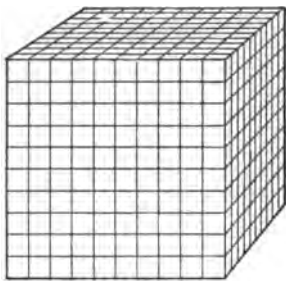


Figure 4.

2. How many blocks like Figure 3 does Figure 4 contain? How many like Figure 2? Like Figure 1?

3. If Figure 4 represents a cubic foot, what part of a cubic foot does Figure 3 represent? Figure 2? Figure 1?

4. What part of a dollar is 1 cent? What part of a dollar is $\frac{1}{10}$ of a cent?

$\frac{1}{10}$ of a cent, or $\frac{1}{1000}$ of a dollar, is called a *mill*. The mill is often used in problems relating to taxes; otherwise it has little use.

5. 5 mills are what part of a dollar? 8 mills are what part of a dollar?

6. 25 mills are what part of a dollar? 125 mills are what part of a dollar?

138. A number of thousandths is expressed by 3 decimal places, the third place at the right of the decimal point being called **thousandths' place**.

Thus, 3 thousandths is expressed decimally by .003. 15 thousandths is expressed decimally by .015; and 625 thousandths by .625.

WRITTEN EXERCISES

Express decimally :

1. Seventeen thousandths.
2. Eight hundred forty-three thousandths.
3. One hundred twenty-five thousandths.
4. Nine thousandths.
5. Eighty-five thousandths.
6. Sixty-six thousandths.
7. Nine hundred ninety-five thousandths.
8. One hundred and five thousandths.
9. Two hundred and twenty-two thousandths.
10. 13 tenths. 40 tenths. 3 tenths.
11. 105 tenths. 40 hundredths.
12. Express as hundredths: .3; .5; .7; .6; 8; 15.
13. Express as thousandths: .05; .01; .3; .08; 10; 25.
14. $\frac{45}{1000}$. 17. $\frac{15}{100}$. 20. $\frac{809}{1000}$. 23. $\frac{106}{10}$. 26. $\frac{400}{1000}$.
15. $\frac{125}{1000}$. 18. $\frac{56}{10}$. 21. $\frac{999}{1000}$. 24. $\frac{1}{1000}$. 27. $\frac{11}{100}$.
16. $\frac{222}{1000}$. 19. $\frac{9}{1000}$. 22. $\frac{21}{10}$. 25. $\frac{205}{1000}$. 28. $\frac{202}{100}$.

Write in words :

- | | | | |
|-----------|-----------|-----------|-------------|
| 29. .125. | 32. .025. | 35. .007. | 38. 30.030. |
| 30. .675. | 33. .806. | 36. .001. | 39. 94.940. |
| 31. .101. | 34. .444. | 37. .005. | 40. 83.066. |

Write each number with the decimal as a common fraction :

- | | | | |
|-----------|--------------|-----------|------------|
| 41. 10.9. | 45. 21.001. | 49. .005. | 53. 50.07. |
| 42. .110. | 46. 121.121. | 50. 1.09. | 54. .044. |
| 43. .015. | 47. 1.006. | 51. .001. | 55. .076. |
| 44. .225. | 48. 46.046. | 52. .365. | 56. .625. |

ADDITION AND SUBTRACTION

139. PREPARATORY.

Read the following problems aloud and state the sums :

- | | | | | |
|--------------|------------|-----------|------------|-------------|
| 1. 5 ft. | 2. \$5 | 3. .5 | 4. .05 | 5. .015 |
| <u>3 ft.</u> | <u>\$3</u> | <u>.3</u> | <u>.03</u> | <u>.025</u> |

Read the following problems aloud and state the differences :

- | | | | | |
|---------------|-------------|------------|------------|----------------|
| 1. 16 yd. | 2. \$16 | 3. .16 | 4. 1.6 | 5. 2.8 ft. |
| <u>12 yd.</u> | <u>\$12</u> | <u>.12</u> | <u>1.2</u> | <u>1.9 ft.</u> |

140. EXAMPLES:

1. A farmer sowed 4 pieces of land and used 5.3 bu., 2.5 bu., 10.1 bu., and .8 bu. of seed, respectively. How much did he sow in all?

$$\begin{array}{r} 5.3 \text{ bu.} \\ 2.5 \\ 10.1 \\ \underline{.8} \\ 18.7 \text{ bu.} \end{array}$$

We place the whole numbers under the whole numbers, and the decimals under the decimals; and we add as with whole numbers, placing the decimal point in the sum under the decimal points of the addends.

2. An acre of land produced 28.45 bu. of wheat. When sown with oats it produced 32.75 bu. How many more bushels of oats than of wheat did it produce?

32.75 bu.	We place the whole number to be subtracted under the whole number of the minuend, and the decimal under the decimal of the minuend.
<u>28.45</u>	We subtract as with whole numbers, placing the decimal point in the difference under the decimal points of the given numbers.
4.30 bu.	

- 141.** *To add or subtract decimals, write like orders in a column and proceed as with integers, placing the decimal point in the result under the decimal points in the given numbers.*

WRITTEN EXERCISES

1. A man bought 1 bu. of oats at \$.40, 1 bu. of wheat at \$.90, 1 bu. of beans at \$1.20, and 1 bu. of grass-seed at \$3.30. How much did he pay for all?

2. When apples are bought at \$1.86 per bushel and sold at \$2.30, what is the gain per bushel?

3. Archie's cyclometer stood at 147.64 mi. when he started on a bicycle ride. On his return it stood at 161.87 mi. How far did he ride?

4. Three tanks for distilling water produce 1.20 gal., .75 gal., and 2.08 gal., respectively, per hour. How many gallons do they distil together in one hour?

5. The length of a rectangular court is 25.75 yd., and its width is 18.9 yd. What is the length of a fence around the court?

6. An automobile traveled 288.4 mi. one day, 240.85 mi. the next, and 301.38 mi. the next. How many miles did it travel in the three days?

7. A man's school tax was 15 mills per dollar of valuation, his land tax 7 mills per dollar, and his water tax 1 mill per dollar. How much did he pay per dollar in taxes?

8. The inside of a freight car was 31.65 ft. long and 6.78 ft. wide. How much longer than wide was the car?

9. A tank contained 525.45 gal., from which 399.75 gal. were drawn. How many gallons were left?

10. One building is 86.88 ft. high, and another 186.66 ft. Find the difference in their heights.

11. One piano wire is 4.125 ft. long, and another is 2.365 ft. long. What is the difference in their lengths?

12. An airship was sailed from towns A to B 10.136 mi., then to town C in the same straight line 15.085 mi.; the ship came back the same way and landed 18.943 mi. from C. How far was this from A?

MULTIPLICATION

Multiplication of a Decimal by an Integer

142. PREPARATORY.

1. How many are 3 times 3 tops? How many are 3 times 3 tenths? Express 9 tenths decimally.

2. How many are 7 times 6 hours? How many are 7 times 6 hundredths? Express the result decimally.

3. How many feet are 3 times 5 feet? How many hundredths are 3 times 5 hundredths? Express decimally 15 hundredths.

4. 3×8 hundredths = ()? 5. 6×21 hundredths = ()?

143. EXAMPLE: A triangle measured 2.55 rd. on each side. What was the distance around it?

$$\begin{array}{r} 2.55 \\ \times 3 \\ \hline 7.65 \end{array}$$

The work is the same as in multiplying 255 by 3; but, as the multiplicand is a number of hundredths, the result is a number of hundredths; and we indicate it by pointing off two places in the product.

144. *To multiply a decimal by an integer, multiply as with integers, and point off as many decimal places in the product as there are decimal places in the multiplicand.*

WRITTEN EXERCISES

Express the results decimally:

1. 5 times 9 tenths. 5 times .9.
2. 3 times 12 tenths. 3 times 1.2.
3. 4 times 202 tenths. 4 times 20.2.
4. 3 times 108 hundredths. 3 times 1.08.
5. 15 times 375 hundredths. 15 times 3.75.
6. 4 times 16 thousandths. 4 times .016.
7. 25 times 146 thousandths. 25 times .146.

Multiply:

8.	.7	13.	3.9	18.	.60	23.	9.6
	<u>9</u>		<u>9</u>		<u>5</u>		<u>24</u>
9.	2.9	14.	.18	19.	2.5	24.	200.1
	<u>15</u>		<u>3</u>		<u>4</u>		<u>78</u>
10.	.07	15.	.8	20.	104.9	25.	.75
	<u>19</u>		<u>6</u>		<u>46</u>		<u>38</u>
11.	.9	16.	10.6	21.	.003	26.	.105
	<u>7</u>		<u>97</u>		<u>12</u>		<u>105</u>
12.	20.06	17.	1.265	22.	4.999	27.	15.088
	<u>214</u>		<u>318</u>		<u>135</u>		<u>26</u>

Solve:

28. What does it cost to ride from New York City to Buffalo, a distance of 440 miles, at the rate of \$.02 a mile?

29. The side of a square building is 43.98 ft. Find the distance around the building.

30. How long is a walk containing 116 sections each 4.75 ft. long?

31. How high is a card file containing 12 sections each 4.25 in. high?

32. How far can a motor cycle go in 7 hours if it travels 28.87 mi. per hour?

33. At \$2.05 a day, how much does a man earn in 26 days?

34. How many miles will a train travel in 24 hr. if its rate is 40.478 mi. per hour?

35. A truck is 10 ft. long, and a teamster wishes to place 3 boxes 39.79 in. long within this length. Can he do it?

36. If 125 bricks 2.255 in. thick are laid one upon the other, how high will the pile be?

37. The wheel on an automobile was 8.665 ft. in circumference. How many feet did the machine travel while the wheel made 510 revolutions?

Multiplication of a Decimal by 10 and by 100

145. PREPARATORY.

1. How many tenths of a dollar are ten times one tenth of a dollar? How many dollars?

2. How many tenths of a dollar are ten times two tenths of a dollar? How many dollars?

3. 10 times 1 tenth = ()? 10 times .2 = ()?

4. 10 times 35 tenths = ()? 10 times 3.5 = ()?

5. 10 times 405 tenths = ()? 10 times 40.5 = ()?

146. *A decimal is multiplied by 10 by moving the decimal point 1 place to the right.*

147. PREPARATORY.

1. How many hundredths in 1.20? In 4.50? In 7.25? 10.05? 9.75? 20.09? 16.3? 24? 12.5?

2. 100×625 hundredths = ()?

100×6.25 = ()?

100×62.5 = ()?

148. *A decimal is multiplied by 100 by moving the decimal point two places to the right.*

ORAL EXERCISES

1. What is the cost of 10 Dictionaries at \$9.85 each? How is the result found?

2. What is the cost of 10 pairs of skates at \$2.75 a pair?

3. At the rate of .45 mi. per minute, how far does a train travel in 100 minutes? How is the result found?

4. How is a decimal multiplied by 10? By 100?

5. The following are prices of various kinds of tea sold in 10-lb. lots;

Common Japan.....	\$.22	Extra Hyson.....	\$.29
Choice Japan.....	.27	Fancy Oolong.....	.37
Green Japan.....	.23	Ceylon.....	.25

What is the cost of 10 lb. of each kind? Of 100 lb. of each?

6. Give the cost of 100 articles of each kind:

Trunks.....	\$5.50	Dictionaries.....	\$9.75
Tables.....	18.75	Coats.....	16.60
Wagons.....	62.25	Typewriters.....	60.50
Sleds.....	3.50	Desks.....	8.35

WRITTEN EXERCISES

Multiply by 10 by moving the decimal point :

1. .3. 3. .7. 5. .9. 7. 1.1. 9. 11.93.
2. 20.12. 4. 29.8. 6. 196.75. 8. 400.3. 10. 287.1.

Multiply by 100 by moving the decimal point :

11. .25. 13. .50. 15. 1.25. 17. 1.13. 19. 4.05.
12. 13.65. 14. .01. 16. 2.225. 18. .675. 20. 3.125.

BILLS

149. Hundredths occur in problems relating to dollars and cents. Making and footing bills, or accounts, is one of the chief uses of decimals, requiring addition and multiplication.

ORAL EXERCISES

1. What is the cost of 2 lb. of tea at \$.45 a pound?
2. What is the cost of 3 lb. of coffee at \$.40 a pound?
3. What is the cost of 5 lb. of lard at \$.08 a pound?

State the cost of :

- | | |
|--------------------------------|----------------------------------|
| 4. 4 yd. lace, @ \$.15. | 7. 2½ yd. silk, @ \$1.00. |
| 5. 8 sticks of braid, @ \$.06. | 8. ½ doz. doilies, @ \$.12 each. |
| 6. 8 yd. woolen, @ \$.75. | 9. 10 yd. calico, @ \$.06½. |

WRITTEN EXERCISES

1. Copy the items of the following bill; find the cost of each article and the total of the bill:

<div> John Wanamaker <i>Broadway, 4th, 9th, 11th and 14th Sts.</i> <i>New York</i> Purchase for Mr. Charles Sampson, 512 West 115th Street, New York City, </div>					
Ques.	Ans.	Due upon account previously rendered.		Debit Total.	Credit.
		2½ Yd. Waist Goods .50			
		3 " " " .50			
		7 " Lawn .20			
		12 Handkerchiefs .12 1/2			
		1 Blanket 3.00			
		1 Comfort 2.50			
		6 Towels .25			
		2 Sheets .75			
		4 " .60			
		4 Cases .12 1/2			

Find the amount of each of the following bills :

2. A customer bought of a baker and confectioner:

Candy	\$.50	Cheese	\$.18	Bread	\$.20
Cookies .....	.10	Wafers .....	.08	Cake .....	.30
Pies .....	.50	Nuts .....	.25	Fruit .....	.35

3. A family bought from a grocer:

Jan. 1. Figs .....\$ .18	Jan. 9. Eggs.....\$.35	Jan. 20. Gelatine..\$.15
Dates .... .08	Soap ..... .25	Bananas... .10
Coffee .... .35	Clothes line. .30	Saltines .. .15
Peas ..... .30	Corn ..... .30	Salmon... .25
Oranges .. .25	Jan. 15. Butter..... .90	Jan. 26. Crackers... .10
Bananas... .10	Coffee ..... .30	Butter ... .90
Nuts ..... .15	Celery..... .10	Oil..... .13
Butter ... .90	Potatoes... .20	Coffee .... .35
Celery.... .15	Oil..... .18	Tea..... .60

4. A lady purchased at a dry-goods store:

3 bolts of lace .....at \$1.00	4 sheets.....at \$.70
18 rolls cotton batting " .11	2 sheets..... " .58
9½ yd. outing flannel " .12	18 yd. muslin..... " .07

5. A restaurant keeper purchased at the market:

2 lb. beefsteak .....at \$.16	2½ lb. veal .....at \$.15
3 " chicken " .18	3 " boiled ham " .13
4 " kettle roast " .08	3½ " beef stew " .10
2 qt. oysters " .35	2½ " sausage..... " .12

6. Bought of Baker and Taylor: 25 copies Shakespeare (school ed.), at \$1.25 each; 70 copies Scott's "Lady of the Lake," at \$.75 each; 1 gross (12 doz.) copy books, at \$.75 per doz.; 12 class registers, at \$.25 each.

7. Bought of Macy and Co.: Aug. 1, 25 yd. Am. prints at \$.07 a yd.; 24 yd. Janesville sheeting at \$.08; 12 yd. damask toweling at \$.15; Aug. 15, 5 cotton spreads at \$3.25 each; 15 yd. pillow tubing at \$.25.

8. Bought of Best & Co. May 2, 12 children's suits at \$2.15 each; 40 pairs of children's shoes at 58 cts. a pair. June 10, 36 children's coats at \$3.75 each; 24 children's bonnets at 39 cts. each.

9. Bought of Roger, Nash, & Co.: Sept. 1, 20 men's suits at \$12.40 each; 35 overcoats at \$19.60 each; Oct. 5, 15 silk vests at \$2.85 each; 4 dozen men's hats at \$1.45 each.

10. Using your own name as purchaser, write bills for Exercises 6 and 9.

DIVISION

Division of a Decimal by an Integer

150. EXAMPLE: Divide \$36.12 by 6.

$$\begin{array}{r} \$6.02 \\ 6 \overline{) \$36.12} \end{array}$$

In dividing \$36.12 by 6, how do we know when the dollars, or the integral part of the quotient, have been found?

151. *To divide a decimal by an integer, divide as with integers and place the decimal point in the quotient as soon as the integral part of the dividend has been divided.*

EXAMPLE: Divide \$7 by 3.

$$\begin{array}{r} \$2.33\frac{1}{3} \\ 3 \overline{) \$7.00} \end{array}$$

In this example, if the division were continued there would always be a remainder; but it would be useless to carry the division farther than cents, because we have no coins of lower value. Stopping when two decimal places of the quotient have been found is called carrying the division to *two decimal places*. In dividing numbers other than cents, it may be necessary to carry the quotient to more places.

WRITTEN EXERCISES

Divide, carrying any inexact divisions to two decimal places:

- | | | | |
|---------------------|---------------------|---------------------|---------------------|
| 1. $3.00 \div 5$ | 6. $3.5 \div 5$ | 11. $3.05 \div 6$ | 16. $37.2 \div 9$ |
| 2. $32.8 \div 8$ | 7. $.25 \div 7$ | 12. $4.65 \div 15$ | 17. $1.625 \div 25$ |
| 3. $1.47 \div 7$ | 8. $2.5 \div 5$ | 13. $3.00 \div 7$ | 18. $18.42 \div 42$ |
| 4. $.169 \div 13$ | 9. $9.6 \div 12$ | 14. $3.16 \div 3$ | 19. $224.3 \div 81$ |
| 5. $3.2 \div 9$ | 10. $.49 \div 7$ | 15. $3.12 \div 6$ | 20. $99.74 \div 34$ |
| 21. $40.35 \div 19$ | 24. $2.05 \div 45$ | 27. $30.63 \div 36$ | |
| 22. $28.16 \div 14$ | 25. $12.15 \div 55$ | 28. $2.005 \div 15$ | |
| 23. $17.09 \div 13$ | 26. $89.65 \div 75$ | 29. $1.008 \div 11$ | |

Solve :

30. When 8 pairs of shoes cost \$17.20, what is the price per pair?

31. An implement dealer bought 9 farm wagons of the same kind for \$436.50. What did he pay for each?

32. A farmer sold 65 bu. of oats for \$32.75. How much did he receive a bushel?

33. A fence 43.2 yd. long contains 12 equal lengths. How many yards in each length?

34. A teamster drew away 13.5 cu. yd. of earth in 15 equal loads. How many cubic yards did he draw per load?

35. From a roll of 862.4 yd. of wire, 28 equal lengths are cut. What is the length of each piece?

36. A lot of 45 overcoats of the same kind cost a merchant \$735.75. How much did he pay per coat?

37. 38 sets of books were sold at wholesale for \$361. How many dollars did they bring per set?

Division of a Decimal by 10 and by 100

152. PREPARATORY.

1. How may the result of multiplying a decimal number by 10 be found easily? The result of multiplying by 100?

2. $10 \times .3 = ()$? Then, .1 of 3 = ()?

3. $10 \times 3.2 = ()$? Then, .1 of 32 = ()?

4. $100 \times .05 = ()$? Then, .01 of 5 = ()?

5. $100 \times 3.25 = ()$? Then, .01 of 325 = ()?

153. *To divide a decimal by 10, move the decimal point one place to the left.*

154. *To divide a decimal by 100, move the decimal point two places to the left.*

ORAL EXERCISES

Divide by 10 and state the answer :

- | | | | | |
|---------|-----------|----------|--------|------------|
| 1. 3.5. | 3. 2,005. | 5. .5. | 7. 20. | 9. 20.8. |
| 2. 9.5. | 4. 9,675. | 6. 27.5. | 8. 35. | 10. 200.5. |

Divide by 100 and state the answer :

- | | | | | |
|------------|------------|----------|------------|------------|
| 11. 47.11. | 15. 3,500. | 19. 35. | 23. 625. | 27. 6,250. |
| 12. 862.5. | 16. 37.50. | 20. 15. | 24. 9.4. | 28. 1,025. |
| 13. 17.5. | 17. 4,309. | 21. 350. | 25. 100.5. | 29. 36.81. |
| 14. 60.05. | 18. 60.95. | 22. 27. | 26. 20.40. | 30. 30.09. |

Solve :

31. The area of a rectangle is 25.5 sq. in., and the height is 10 in. What is the length of the base?

Plan : Since $10 \times \text{base} = 25.5$, the base = $\frac{1}{10}$ of 25.5.

32. The area of a rectangle is 23.5 sq. ft., and the base is 10 ft. What is the height?

Plan : Since $10 \times \text{altitude} = 23.5$, the altitude = $\frac{1}{10}$ of 23.5.

33. The area of a rectangle is 327.5 sq. in., and the base is 100 in. Find the height. Use A to indicate height.

Plan : Since $100 \times A = 327.5$, $A = \frac{1}{100}$ of 327.5.

34. If it costs \$2.50 to ride 100 mi. on the railroad, what is the rate per mile?

35. A man received \$18.50 for 10 days' work. How much was this per day?

36. When the freight on 1000 lb. of books is \$16.80, what is the rate per pound? Per 100 lb?

37. An automobile was driven 295.5 mi. in 10 hr. How many miles was this per hour?

38. The following shows the cost of 10 articles of each kind. What was the cost of 1?

Chairs, \$42.50.	Stoves, \$200.00.	Tables, \$82.50.
Desks, \$95.50.	Bookcases, \$150.50.	Pictures, \$74.20.

REDUCTION

Reduction of a Decimal Fraction to a Common Fraction

155. PREPARATORY.

$$1. .5 = \left(\frac{5}{10}\right)? \quad \frac{5}{10} = \left(\frac{1}{2}\right)? \quad 2. .04 = \left(\frac{4}{100}\right)? \quad \frac{4}{100} = \left(\frac{1}{25}\right)?$$

156. *To reduce a decimal fraction to a common fraction, supply the denominator of the decimal fraction and reduce to lowest terms.*

$$\text{Thus, } .025 = \frac{25}{1000} = \frac{1}{40}.$$

$$\text{Also, } .16\frac{2}{3} = \frac{16\frac{2}{3}}{100} = \frac{50}{3} \times \frac{1}{100} = \frac{1}{6}.$$

$$\text{Also, } 2.05 = 2\frac{5}{100} = 2\frac{1}{20}.$$

WRITTEN EXERCISES

Reduce to common fractions in lowest terms:

- | | | | | | |
|--------|----------|---------|-----------|-----------|-----------|
| 1. .3. | 4. .625. | 7. .12. | 10. 17.5. | 13. .075. | 16. .16. |
| 2. .4. | 5. 9.75. | 8. .01. | 11. .125. | 14. 4.05. | 17. .25. |
| 3. .8. | 6. .45. | 9. .40. | 12. 4.25. | 15. .375. | 18. .008. |

Reduction of a Common Fraction to a Decimal Fraction

157. PREPARATORY.

1. How is $\frac{1}{2}$ changed to an equal fraction whose denominator is 10? How is $\frac{2}{10}$ expressed decimally?

2. How is $\frac{3}{5}$ changed to an equal fraction whose denominator is 100? How is $\frac{12}{100}$ expressed decimally?

3. How is $\frac{7}{8}$ changed to an equal fraction whose denominator is 1000? How is $\frac{7}{8}$ expressed decimally?

4. How is $\frac{19}{100}$ expressed as thousandths? Express $\frac{19}{100}$ decimally.

WRITTEN EXERCISES

Express decimally:

- | | | | | | |
|---------------------|---------------------|--------------------|-----------------------------|------------------------|-----------------------|
| 1. $\frac{2}{5}$. | 4. $\frac{3}{5}$. | 7. $\frac{4}{5}$. | 10. $\frac{1\frac{3}{4}}$. | 13. $\frac{40}{125}$. | 16. $\frac{19}{40}$. |
| 2. $\frac{3}{4}$. | 5. $\frac{5}{8}$. | 8. $\frac{6}{8}$. | 11. $\frac{1}{4}$. | 14. $\frac{128}{50}$. | 17. $\frac{11}{25}$. |
| 3. $\frac{6}{25}$. | 6. $\frac{9}{50}$. | 9. $\frac{2}{8}$. | 12. $\frac{9}{10}$. | 15. $\frac{51}{200}$. | 18. $\frac{3}{20}$. |

158. To express any fraction decimally, divide the numerator by the denominator.

EXAMPLE: Express $\frac{2}{3}$ decimally.

$$\begin{array}{r} .66\bar{3} \\ 3 \overline{)2.00} \end{array}$$

The 2 units are regarded as 20 tenths. This gives a quotient .6 with a remainder of .2. These are regarded as 20 hundredths, and the resulting quotient is .06, with a remainder of .02. The further division of this remainder by 3 may be indicated by $\frac{2}{3}$ placed in the quotient. More than two or three decimal places are seldom required.

WRITTEN EXERCISES

Express decimally to two places:

- | | | | | |
|---------------------|---------------------|----------------------|----------------------|-----------------------|
| 1. $\frac{1}{3}$. | 5. $\frac{1}{8}$. | 9. $\frac{1}{4}$. | 13. $\frac{5}{8}$. | 17. $12\frac{7}{8}$. |
| 2. $\frac{5}{8}$. | 6. $\frac{7}{8}$. | 10. $\frac{3}{8}$. | 14. $\frac{7}{8}$. | 18. $7\frac{1}{4}$. |
| 3. $\frac{1}{11}$. | 7. $\frac{7}{11}$. | 11. $\frac{1}{12}$. | 15. $\frac{5}{12}$. | 19. $8\frac{5}{8}$. |
| 4. $1\frac{2}{3}$. | 8. $5\frac{5}{8}$. | 12. $2\frac{7}{8}$. | 16. $9\frac{5}{8}$. | 20. $16\frac{2}{3}$. |

159. Some decimals are more convenient to use in multiplication and division when expressed in the common fraction form.

TABLE OF EQUIVALENTS

$.05 = \frac{1}{20}$	$.16\bar{3} = \frac{1}{6}$	$.62\frac{1}{2} = \frac{5}{8}$
$.20 = \frac{1}{5}$	$.33\frac{1}{3} = \frac{1}{3}$	$.66\bar{3} = \frac{2}{3}$
$.25 = \frac{1}{4}$	$.37\frac{1}{2} = \frac{3}{8}$	$.75 = \frac{3}{4}$
$.12\frac{1}{2} = \frac{1}{8}$	$.50 = \frac{1}{2}$	$.87\frac{1}{2} = \frac{7}{8}$

ORAL EXERCISES

1. What part of a dollar is $12\frac{1}{2}$ cts.? What is the cost of a dozen collars at $12\frac{1}{2}$ cts. each?

2. What part of \$100 is $\$12\frac{1}{2}$? What is the cost of 9 harnesses at $\$12\frac{1}{2}$ each?

3. What part of \$100 is $\$33\frac{1}{3}$? What is the cost of 6 suites of furniture at $\$33\frac{1}{3}$ a suite?

4. What part of \$100 is $\$16\frac{2}{3}$? What is the cost of 18 tables at $\$16\frac{2}{3}$ each?

5. A real-estate agent bought some property for \$2,400 and sold it so as to gain $.33\frac{1}{3}$ of what he paid for it. For how much did he sell it?

6. .25 is how many fourths? To divide a number by .25 is to divide it by what fraction?

WRITTEN EXERCISES

Divide by .25, using the shortest method :

- | | | | |
|-------------|---------------|-------------|-------------|
| 1. 17.5. | 3. \$3.75. | 5. 25.50. | 7. 4.25 mi. |
| 2. \$46.50. | 4. 20.125 lb. | 6. 3.03 ft. | 8. 50.775. |

Solve :

9. What is the cost of 42 dozen pencils at $33\frac{1}{3}$ cts. per dozen?

10. $.33\frac{1}{3}$ is how many thirds? To divide by $.33\frac{1}{3}$ is to multiply by what number?

11. When $.33\frac{1}{3}$ of a yd. of cloth costs \$1.70, what is the price per yard?

12. When silk is $66\frac{2}{3}$ cts. a yard, what is the cost of 30 yd.?

13. What is the cost of 40 bu. of potatoes at $87\frac{1}{2}$ cts. a bushel?

14. What is the cost of 12 lb. of tea at $66\frac{2}{3}$ cts. a pound?

15. What is the cost of 65 lb. of butter at 20 cts. a pound?

16. What is the cost of 36 lb. of cheese at $16\frac{2}{3}$ cts. a pound?

17. What is the cost of 24 lb. of coffee at $37\frac{1}{2}$ cts. a pound?

REVIEW

ORAL EXERCISES

1. Express as hundredths: .4; .9; .12.
2. Express as tenths: .40; .80; 2.60.
3. Express as thousandths: .04; .07; .6.
4. Add 2.5, .4, .6, .3.
5. Subtract .9 from 2.6. .3 from 3. 1.4 from 5.6.
6. At $12\frac{1}{2}$ cts. per yd., what is the cost of 3 yd. of ribbon?
Of 5 yd.? 7 yd.? 8 yd.? 11 yd.?
7. Multiply .4 by 9. .7 by 4. .8 by 5. .5 by 9.
8. Multiply 3 by .16. 3 by 1.6. 4 by 1.5. 4 by .15.
9. Express in hundredths: 1.40; 6.30; 20.8; 9.6; 4.05.
10. How many times $33\frac{1}{2}$ cts. is \$1? \$1.33 $\frac{1}{2}$? \$1.66 $\frac{2}{3}$?
\$2? \$2.66 $\frac{2}{3}$? \$2.33 $\frac{1}{3}$? \$5?
11. At the rate of .55 mi. in a minute, how far does a train go in 10 min.? In 100 min.?
12. What is the cost of 100 chairs at \$5.55 apiece? Of 100 tables at \$13.40 apiece? Of 10 books at \$1.63 apiece?
13. What is the cost of 3 lb. of sugar at \$.15 a lb.? Of 4 lb. of tea at \$.45? Of 6 lb. of candy at \$.35? Of $3\frac{1}{2}$ yd. of silk at \$1.50? Of $\frac{1}{2}$ doz. buttons at \$.12 each?
14. At $12\frac{1}{2}$ cts. a pound, how many pounds of sugar can be bought for \$1?
15. Divide by 10: 6.5; 3.4; 3.5; 48.6; 912.7.
16. The area of a rectangle is 45.5, and the altitude is 10 in. What is the length of the base?
17. If it costs \$3 to ride 100 mi. on the railroad, what is the rate per mile?
18. A train went 365.5 mi. in 10 hr. How many miles did it go in one hour?

19. What part of 25 cts. is $12\frac{1}{2}$ cts.? What part of \$1 is 25 cts.? What part of \$1 is $12\frac{1}{2}$ cts.?

20. How many times $12\frac{1}{2}$ cts. is $37\frac{1}{2}$ cts.? What part of a dollar is $37\frac{1}{2}$ cts.?

WRITTEN EXERCISES

1. Reduce to common fractions in lowest terms: .6; 4.36; .03; .705; .075; .5; .004.

2. Express decimally: $\frac{3}{8}$; $\frac{4}{5}$; $\frac{7}{8}$; $\frac{3\frac{1}{2}}{1\frac{2}{3}}$; $\frac{1\frac{2}{3}}{1\frac{1}{2}}$.

3. Divide, carrying any inexact division to two decimal places: $4.5 \div 5$; $.36 \div 6$; $7.2 \div 9$; $.143 \div 17$; $8.00 \div 7$; $2.004 \div 11$.

4. Express decimally to two places: $\frac{2}{3}$; $\frac{4}{5}$; $\frac{7}{8}$; $\frac{1}{1\frac{1}{2}}$; $2\frac{5}{12}$; $\frac{4}{11}$.

5. A field is 25.4 ft. on one side, 14.06 ft. on another, 32.35 ft. on another, and 13.6 ft. on the fourth side. Find the distance around the field.

6. An acre of land produced 36.25 bu. of corn; when sown with wheat it produced 24.65 bu. How many more bushels of corn than of wheat did it produce?

7. The water runs into 3 cisterns at the rate of 12.06 gal., 5.6 gal., and 1.35 gal., respectively, per hour. How many gallons run into all three cisterns in one hour? In 10 hr.?

8. One building is 74.9 ft. high, and another 145.03 ft. Find the difference in their heights.

9. How far can a train go in 6 hr. if it travels 37.92 mi. per hour?

10. A man earns \$3.35 a day. How much does he earn in 14 days?

11. If 123 boxes each 6.09 in. in height are piled one on the other, what will be the height of the pile?

12. A square is 2.4 ft. on a side. Find its perimeter.

13. A triangle is 13.7 in. on each side. Find its perimeter.

14. A subscription agency offers the following sets of magazines at the prices quoted:

ALL OFFERS ARE FOR ONE FULL YEAR.	
Walker's and McClure's	\$2.50
Walker's and Scribner's Magazine	4.00
Walker's and Harper's Magazine	4.50
Walker's and Century Magazine	4.50
Walker's and McClure's and Munsey's	3.35
Walker's and McClure's and Cosmopolitan	3.35
Walker's and Munsey's and Cosmopolitan	2.80
Walker's and McClure's and Ainslee's	3.50
Walker's and Munsey's and Ainslee's	2.90
Walker's and Ainslee's and Pearson's	2.80
Walker's and Cosmopolitan	2.00
Walker's and Munsey's	2.10
Walker's and Ainslee's	2.35
Walker's and Ledger Monthly	1.75
Walker's and Youth's Companion	2.85

If the regular subscription price of Walker's and McClure's magazines is \$1.50 each per year, how much is saved in a year by accepting the offer of the agency?

15. If the regular price of Scribner's is \$3, how much is saved by accepting the second offer of the agency?

16. Answer the same question for the third, fourth, and fifth offers, taking the regular price of Harper's as \$4, of the Century as \$4, and of Munsey's as \$1.

17. Make and solve 10 other problems, taking the regular price of the Cosmopolitan as \$1, of Ainslee's as \$1.50, of Pearson's as \$1, of the Ledger Monthly as \$1, and of the Youth's Companion as \$1.75.

18. A man wishes to fence a rectangular lot 60 ft. by 110 ft. with netting at 40 cts. per roll of 100 ft. If broken rolls are not sold, how much must he pay for the netting?

19. Find the cost of 12 yd. of broadcloth at \$2.30 per yard and 18 yd. of lining silk at 59 cts. per yard.

20. The table shows the cost per person of various necessities during a recent period of 8 years:

YEAR.	BREADSTUFFS.	MEATS.	CLOTHING.
1	\$10.504	\$7.058	\$13.602
2	10.587	7.529	13.808
3	12.783	7.694	14.663
4	13.483	7.988	15.021
5	14.898	8.906	16.324
6	14.904	9.430	15.098
7	20.534	11.628	15.533
8	17.473	9.269	17.136

Find the increase or decrease in the cost of each item from year to year.

21. Find the cost of a roll, 150 running feet, of wire netting at 38 cts. per 100 ft.

22. Find the cost of 27 fruit-jars at 84 cts. per dozen, 18 tumblers at 72 cts. per dozen, 9 goblets at \$1.80 per dozen, and 40 cups at \$1.50 per dozen.

23. Find the cost of $\frac{1}{2}$ gross of photographic paper (1 gross = 12 dozen) at 94 cts. per gross, $\frac{2}{3}$ of a gross of pencils at \$1.50 per gross, $\frac{3}{4}$ dozen inkstands at \$.35 each.

24. At 3 cts. per foot, what is the cost of sufficient picture-molding to go around a room 14 ft. by 17 ft.?

25. A man bought a 25-foot lot at \$15.50 per foot. Later he bought two adjacent 20-foot lots at \$24.75 per foot. Still later he bought a 40-foot corner lot adjacent to one of these at \$41.25 per foot.

20 ft.	25 ft.	20 ft.	40 ft.
--------	--------	--------	--------

How much did he pay for all?

26. The lots of Exercise 25 were

125 ft. deep. What is the cost of a fence surrounding the whole plot at 65 cts. per running foot?

CHAPTER IV

DENOMINATE NUMBERS

160. Concrete numbers relating to units of measure are called **denominate numbers**.

Thus, \$2; 6 oz.; 3.5 ft.; 4 gal.; 2 qt., are denominate numbers.

161. Denominate numbers expressed in terms of two or more units are called **compound numbers**.

Thus, 2 mi. 60 rd. 10 ft. is a compound number.

162. MEASURES OF CAPACITY

Liquid Measure

<p>4 gills (gl.) - 1 pint (pt.). 2 pints - 1 quart (qt.). 4 quarts - 1 gallon (gal.).</p>

Barrels (bbl.) are of various sizes, but $31\frac{1}{2}$ gal. is to be taken as the capacity of a barrel unless otherwise stated. 2 bbl. - a hogshead.

Dry Measure

<p>2 pints (pt.) - 1 quart (qt.). 8 quarts - 1 peck (pk.). 4 pecks - 1 bushel (bu.).</p>
--

ORAL EXERCISES

- 1 qt. is what part of a gallon?
- 1 pk. is what part of a bushel?

Express :

3. 5 gal. as quarts. 6. 2 pt. as gills. 9. $2\frac{1}{2}$ qt. as pints.
4. 3 bu. as pecks. 7. 2 gal. as pints. 10. 2 pk. as quarts.
5. 1 pk. as pints. 8. 1 gal. as gills. 11. $2\frac{1}{2}$ bu. as pecks.

WRITTEN EXERCISES

1. How many barrels in a cistern containing 630 gal.?
2. How many bushels in 800 one-quart crates of berries?
3. How many 1-pint bottles can be filled from 90 qt. of milk?
4. How many 5-gallon kegs can be filled from 20 bbl. of vinegar?
5. How many 3-gallon oil tanks can be filled from 6 bbl. of gasoline?
6. How many 2-gallon cans can be filled from 188 qt. of milk?
7. How many half-gallon pails can be filled from 37 gal. 2 qt. of syrup?

163. MEASURES OF WEIGHT AND VALUE

The tables in **bold type** are in everyday use and should be learned thoroughly. The other tables are of limited use.

Avoirdupois Weight

16 ounces (oz.) - 1 pound (lb.).
2,000 pounds - 1 ton (T.).

100 lb. is still sometimes used as a unit of measure and abbreviated cwt. 2,000 lb. is often called a *short ton*, and the ton of 2,240 lb., used at the mines in weighing coal and ores, is called the *long ton* or *gross ton*. A pound avoirdupois (avd.) contains 7,000 grains.

Troy Weight

Valuable metals like gold and platinum are still weighed by troy weight.

24 grains (gr.) = 1 pennyweight (pwt. or dwt.).

20 pennyweights = 1 ounce (oz.).

12 oz. = 1 pound (lb.).

The *carat* weight, used in weighing diamonds, varies; but it should be taken as $3\frac{1}{4}$ troy grains unless otherwise stated.

In speaking of gold as "so many carats fine," one means so many twenty-fourths of pure gold. Thus, gold 14 carats fine is $\frac{14}{24}$ pure gold and $\frac{10}{24}$ alloy (cheaper metals).

Apothecaries' Weight

In preparing prescriptions druggists use apothecaries' weight.

20 grains (gr.) = 1 scruple (sc. or \mathfrak{S}).

3 scruples = 1 dram (dr. or \mathfrak{D}).

8 drams = 1 ounce (oz. or \mathfrak{O}).

12 ounces = 1 pound (lb.).

In the following pages all references to weight pertain to avoirdupois weight unless otherwise stated.

United States Money

Review the table of United States money.

10 cents (ϕ or cts.) = 1 dime.

10 dimes = 1 dollar (\$1).

100 cents = 1 dollar.

ORAL EXERCISES

1. How many pounds avoirdupois in 32 oz.?
2. How many 100-pound bales of hay make a ton?
3. How many ounces in $2\frac{1}{2}$ lb.? In 5 lb.?

4. How many dimes in \$1.40? In \$5.50?

5. How many cents in \$3.50? In \$3.05?

WRITTEN EXERCISES

Express :

1. 96 oz. as pounds (avd.). 5. 120 oz. as pounds (avd.).

2. 2,500 lb. as tons (short). 6. 5,600 lb. as tons (long).

3. $9\frac{1}{2}$ lb. as ounces (avd.). 7. 256 oz. as pounds.

4. $24\frac{1}{2}$ lb. as ounces (avd.). 8. 1872 oz. as pounds (avd.).

9. How many short tons of coal could be sold from a car-load weighing 50 long tons?

10. How many pounds in 48.75 long tons?

Questions on Tables Not Generally Used

1. How many pennyweights in a pound troy?

2. What is meant by saying that a ring is 18 carats gold?

3. How many grains troy does a diamond weigh that weighs 3 carats?

4. How many scruples in an ounce apothecaries'?

5. How many drams in a pound apothecaries'?

6. How many grains in a dram?

7. How many 5-grain powders can be made from a dram of quinine?

8. Express 5 oz. as scruples. Also as drams.

9. Express $2\frac{1}{2}$ lb. as grains (troy). $2\frac{1}{2}$ lb. as grains (apoth.).

10. Find the difference between the number of grains in a pound avoirdupois and the number in a pound troy.

11. How many pennyweights of pure gold in a pin 14 carats fine, weighing 12 pwt.?

12. How many grains in an ounce apothecaries'?

13. How many 4-grain powders can be made from $\frac{1}{2}$ of an ounce of salol?

164.

MEASURES OF TIME**60 seconds (sec.) - 1 minute (min.).****60 minutes - 1 hour (hr.).****24 hours - 1 day (da.).****7 days - 1 week (wk.).****12 months (mo.) - 1 year (yr.).****100 years - 1 century.**

April, June, September, and November have 30 days each. The rest, except February, have 31. February has 28 days (29 in leap years).

There are 365 days in a common year and 366 days in a leap year. Every year whose number is divisible by 4 is a leap year, except that century years are leap years only when divisible by 400.

ORAL EXERCISES

1. How many minutes in 2 hr.? $1\frac{1}{2}$ hr.? $1\frac{1}{3}$ hr.? $\frac{2}{3}$ hr.?
2. How many seconds in $\frac{1}{2}$ min.? $\frac{2}{3}$ min.? $1\frac{1}{3}$ min.?
3. How many days in 10 wk.? In 8 wk.?
4. How many weeks and days in a 30-day month?

165.

MEASURING BY TWELVES**12 units - 1 dozen (doz.).****12 dozen - 1 gross (gr.).****12 gross - 1 great gross.****ORAL EXERCISES**

1. How many pencils in $2\frac{1}{2}$ doz.? In $3\frac{1}{4}$ doz.?
2. How many dozens in $\frac{3}{4}$ gr.? In $2\frac{1}{2}$ gr.? In $\frac{5}{8}$ gr.?
3. How many dozens in 108 eggs? In 144 eggs? In 252?

166. MEASURES OF LENGTH, AREA, AND VOLUME**Linear Measure**

<p>12 inches (in.) = 1 foot (ft.). 3 feet = 1 yard (yd.). 16.5 feet = 1 rod (rd.). 320 rods = 1 mile (mi.). 1,760 yards = 1 mlie. 5,280 feet = 1 mlie.</p>
--

A unit of 6 ft., called the *fathom*, is used to measure depths at sea. A *cable length* is 120 fathoms.

Distances at sea are measured by a *nautical mile*, which equals 1.15 common or statute miles.

Draughtsmen often use the symbols ' and " to express feet and inches. Thus, 5 ft. 6 in. is written 5' 6".

Square Measure

<p>144 square inches (sq. in.) = 1 square foot (sq. ft.). 9 square feet = 1 square yard (sq. yd.). 30½ square yards = 1 square rod (sq. rd.). 160 square rods = 1 acre (A.). 640 acres = 1 square mile (sq. mi.). 36 square miles = a township.</p>

Cubic Measure

<p>1,728 cubic inches (cu. in.) = 1 cubic foot (cu. ft.). 27 cubic feet = 1 cubic yard (cu. yd.).</p>

Surveyors still use a special table as follows:

100 links (7.92 in.) = 1 chain (4 rd. or 66 ft.).
80 chains = 1 mile.
10 square chains = 1 acre.

In measuring excavations, 1 cu. yd. is regarded as a *load*.

In measuring masonry, $24\frac{1}{2}$ cu. ft. is regarded as a *perch* of stone. This is not uniformly used, however.

In measuring wood, a pile of 4-foot wood 8 ft. long and 4 ft. high is called a *cord*. 128 cu. ft. = 1 cord.

A *cord of stove wood* is a pile of wood cut in stove lengths (usually 16 in.) 8 ft. long and 4 ft. high.

ORAL EXERCISES

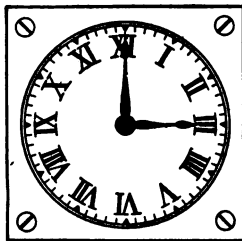
1. How many inches are there in a yard?
2. How many feet are there in 4 rd.?
3. How many yards are there in $\frac{1}{4}$ of a mile?
4. How many square rods in $\frac{1}{4}$ of an acre? In $\frac{1}{4}$ of an acre?
5. How many acres in a square $\frac{1}{4}$ mi. on a side?
6. How many cubic feet in $\frac{1}{4}$ of a cubic yard?

WRITTEN EXERCISES

1. How many cords of wood in 384 cu. ft.?
2. How many acres in a township?
3. How many cubic inches in $5\frac{1}{4}$ cu. ft.?
4. A farm measured 45.8 square chains. How many acres in the farm?
5. Some metal roofing cost at the rate of 1 ct. per square inch. How much was this per square yard?
6. When a balloon was $1\frac{1}{2}$ mi. above the ground, how many feet high was it?
7. How many cubic inches in a block of marble 2 ft. wide, 2 ft. thick, and 4 ft. long?
8. A court 2 rd. wide and $4\frac{1}{2}$ rd. long was paved with cement. How many square yards of cement in the court?
9. How many cubic yards of earth were taken out in excavating a cellar 54 ft. wide, 180 ft. long, and 9 ft. deep?

ANGULAR MEASURE

167. When it is 3 o'clock the hands of a clock form a right angle.



When the minute hand moves from XII to III, it turns through a right angle.

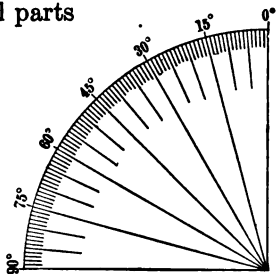
In order to describe the size of angles we suppose a right angle to be divided into 90 equal angles, called **degrees**, indicated by the sign $^{\circ}$.

Each degree is divided into 60 equal parts called **minutes**, indicated by $'$.

Each minute is divided into 60 equal parts called **seconds**, indicated by $''$.

When the hands of a clock form a right angle, as at 3 o'clock, what fraction of the clock-face is included between them?

If we think of the lettered circle of the clock-face as measuring the angles, we see that the circle measures 4 right angles.



TABLE

60 seconds ($60''$) – 1 minute ($1'$).

60 minutes – 1 degree (1°).

90 degrees – 1 right angle.

360 degrees – 4 right angles.

ORAL EXERCISES

1. How many degrees in each angle of a square?
2. How many degrees in one-half of a right angle?
3. How many degrees in an angle containing 2 right angles?

WRITTEN EXERCISES

1. A pie is cut into 4 equal pieces. How many degrees are there in the angle between the sides of each piece? How many degrees are there in the angle of each piece, if the pie is cut into 6 equal pieces? Into 8 equal pieces?

2. A wheel has 8 spokes. What is the angle between each spoke and the next?

3. A ship is sailing north. Through how many degrees must it turn to change its course to northeast?

4. Through how many degrees does the minute-hand of a clock turn in an hour? In $\frac{1}{4}$ hr.? In $\frac{1}{2}$ hr.? In 10 min.? In 5 min.?

5. What is the angle between the hour-hand and the minute-hand at 2 o'clock? At 5 o'clock?

6. How many seconds in $5\frac{1}{4}'$? In $3\frac{1}{2}'$? In 1° ?

7. How many minutes in $1\frac{1}{2}^\circ$? In $5\frac{3}{4}^\circ$?

8. Draw a square and connect the opposite corners by diagonal lines. What is the size of each angle between the cross lines?

9. What is the size of each angle of a rectangle? How many degrees in the sum of the angles of a rectangle?

10. Draw a line from the center of the clock-face to XII, then one to III, and one to VIII. How many degrees in each angle made by these lines?

11. Join the center of the clock-face with the point corresponding to III; join the center with the point corresponding to IX. What is the number of degrees in the angle between these lines?

12. A windmill had 4 sails making 4 equal angles. How many minutes in each of these angles?

13. How many minutes in the angle between the hands of the clock at 4 o'clock?

PROCESSES WITH DENOMINATE NUMBERS

Reduction

168. Changing the form of a denominate number without changing its value is called **reduction**.

Thus, 3 gal. 2 qt. may be expressed as 14 qt. or 28 pt. or $3\frac{1}{2}$ gal.

169. Changing a number to another of lower denomination is called **reduction descending**.

For example, 2 lb. may be changed to 32 oz.

170. EXAMPLE: Reduce 36 gal. 1 qt. to pints.

$$\begin{array}{r} 36 \\ \underline{4} \\ 144 + 1 = 145 \\ \underline{2} \\ 290 \end{array}$$

36 gal. 1 qt. = 290 pt.

(1) Since 1 gal. = 4 qt., 36 gal. = 36×4 qt. = 144 qt.

(2) 144 qt. + 1 qt. = 145 qt.

(3) Since 1 qt. = 2 pt., 145 qt. = 145×2 pt. = 290 pt.

In computing the result, we multiply 36 by 4 instead of multiplying 4 by 36, because the work is easier, and the result is the same.

WRITTEN EXERCISES

Reduce :

- | | |
|--|------------------------------------|
| 1. 1 rd. 5 ft. to inches. | 7. 3 gal. 2 qt. to pints. |
| 2. 4 lb. 2 oz. to ounces. | 8. 1 bu. 20 qt. to quarts. |
| 3. 5 rd. 12 ft. to feet. | 9. 5 pk. 7 qt. to pints. |
| 4. $1\frac{1}{2}$ T. 17 lb. to pounds. | 10. 8' 10" to inches. |
| 5. 12 gross, 8 doz. to units. | 11. 12 yd. 2 ft. to feet. |
| 6. $4\frac{1}{2}$ A. to square rods. | 12. 3 cu. yd. 9 cu. ft. to cu. ft. |

171. Changing a number to another of higher denomination is called **reduction ascending**.

For example, 30 in. may be changed to 2 ft. 6 in.

172. EXAMPLE: Reduce 590 in. to yards.

There are as many feet in 590 in. as 12 in. are contained times in 590 in., or 49 with a remainder of 2 in.

$$\begin{array}{r} 12 \overline{)590} \\ 3 \overline{)49} + 2 \\ 16 + 1 \end{array}$$

There are as many yards in 49 ft. as 3 ft. are contained times in 49 ft., or 16 with a remainder of 1 ft.

16 yd. 1 ft. 2 in. =

$16\frac{1}{18}$ yd.

Therefore 590 in. = 16 yd. 1 ft. 2 in.

1 ft. 2 in. = 14 in. = $1\frac{1}{3}$ yd. = $\frac{7}{18}$ yd. Hence, 16 yd. 1 ft. 2 in. = $16\frac{1}{18}$ yd.

Reduce :

WRITTEN EXERCISES

- | | |
|---------------------------------|-----------------------------------|
| 1. 368 oz. to pounds. | 10. 560 in. to yards. |
| 2. 400 pt. to gallons. | 11. 840 sec. to hours. |
| 3. 340 pk. to bushels. | 12. 250 in. to yards. |
| 4. 3,600 sec. to hours. | 13. 4,060 yd. to miles. |
| 5. 52 wk. to days. | 14. 1,728 cu. in. to cubic feet. |
| 6. 900 things to gross. | 15. 400 sq. in. to square feet. |
| 7. 3,456 cu. in. to cubic feet. | 16. $18\frac{1}{2}$ T. to ounces. |
| 8. 1,865 pt. to gallons. | 17. 3 yr. 10 da. to hours. |
| 9. 878 hr. to days. | 18. 60.5 sq. yd. to square rods. |

Addition and Subtraction

173. EXAMPLES:

1. Add 12 ft. 8 in. and 25 ft. 7 in.

12 ft. 8 in.
 25 ft. 7 in.
 37 ft. 15 in. or
 38 ft. 3 in.

Whenever the sum in any column is larger than the number of units in the next higher denomination, the result must be reduced.
 Hence 15 in. = 1 ft. 3 in., and the 1 ft. is added to the next column.

2. Subtract 17 lb. 9 oz. from 39 lb. 3 oz.

$$\begin{array}{r} 39 \text{ lb. } 3 \text{ oz.} \\ 17 \text{ lb. } 9 \text{ oz.} \\ \hline 21 \text{ lb. } 10 \text{ oz.} \end{array}$$

When the minuend in any column is too small, increase it by the value of a unit from the next left-hand column. Thus, 39 lb. 3 oz. = 38 lb. 19 oz.

174. *To add or subtract compound numbers, add or subtract the numbers of each denomination, and reduce the result, if necessary.*

WRITTEN EXERCISES

Add :

1. $\begin{array}{r} 240 \text{ lb. } 10 \text{ oz.} \\ 15 \text{ lb. } 12 \text{ oz.} \\ \hline \end{array}$

3. $\begin{array}{r} 12 \text{ yd. } 9 \text{ in.} \\ 18 \text{ yd. } 6 \text{ in.} \\ \hline \end{array}$

5. $\begin{array}{r} 17 \text{ bu. } 3 \text{ pk.} \\ 45 \text{ bu. } 2 \text{ pk.} \\ \hline \end{array}$

2. $\begin{array}{r} 25 \text{ gal. } 2 \text{ qt. } 1 \text{ pt.} \\ 12 \text{ gal. } 2 \text{ qt. } 1 \text{ pt.} \\ \hline \end{array}$

4. $\begin{array}{r} 30 \text{ mi. } 100 \text{ rd.} \\ 55 \text{ mi. } 300 \text{ rd.} \\ \hline \end{array}$

6. $\begin{array}{r} 3 \text{ wk. } 6 \text{ da.} \\ 10 \text{ wk. } 8 \text{ da.} \\ \hline \end{array}$

7. $\begin{array}{r} 40 \text{ rd. } 10 \text{ ft. } 6 \text{ in.} \\ 15 \text{ rd. } 8 \text{ ft. } 8 \text{ in.} \\ 12 \text{ rd. } 14 \text{ ft. } 10 \text{ in.} \\ \hline \end{array}$

9. $\begin{array}{r} 7 \text{ wk. } 6 \text{ da. } 20 \text{ min.} \\ 8 \text{ wk. } 5 \text{ da. } 35 \text{ min.} \\ 6 \text{ wk. } 0 \text{ da. } 50 \text{ min.} \\ \hline \end{array}$

8. $\begin{array}{r} 12 \text{ gal. } 3 \text{ qt. } 1 \text{ pt.} \\ 40 \text{ gal. } 2 \text{ qt. } 1 \text{ pt.} \\ 67 \text{ gal. } 1 \text{ qt. } 0 \text{ pt.} \\ \hline \end{array}$

10. $\begin{array}{r} 83 \text{ bu. } 2 \text{ pk. } 6 \text{ qt.} \\ 17 \text{ bu. } 0 \text{ pk. } 7 \text{ qt.} \\ 25 \text{ bu. } 3 \text{ pk. } 0 \text{ qt.} \\ \hline \end{array}$

Solve :

11. A lawn is 12 yd. 2 ft. 9 in. long and 10 yd. 1 ft. 8 in. wide. What is the distance around it?

12. A grocer bought 13 pk. 5 qt. of cherries from one customer 4 bu. 3 pk. 6 qt. from another, and 2 bu. 1 pk. 3 qt. from another. Find the total of these three amounts.

Subtract :

13. $\begin{array}{r} 25 \text{ gal. } 1 \text{ qt.} \\ 12 \text{ gal. } 2 \text{ qt.} \\ \hline \end{array}$

14. $\begin{array}{r} 55 \text{ mi. } 100 \text{ rd.} \\ 35 \text{ mi. } 300 \text{ rd.} \\ \hline \end{array}$

15. $\begin{array}{r} 10 \text{ wk. } 5 \text{ da.} \\ 7 \text{ wk. } 6 \text{ da.} \\ \hline \end{array}$

$$\begin{array}{r} 16. \quad 48 \text{ lb. } 8\frac{1}{2} \text{ oz.} \\ \quad 16 \text{ lb. } 9\frac{3}{4} \text{ oz.} \\ \hline \end{array}$$

$$\begin{array}{r} 17. \quad 90 \text{ bu. } 17 \text{ qt.} \\ \quad 45 \text{ bu. } 9 \text{ qt.} \\ \hline \end{array}$$

$$\begin{array}{r} 18. \quad 18 \text{ rd. } 6\frac{1}{2} \text{ ft.} \\ \quad 9 \text{ rd. } 8\frac{3}{4} \text{ ft.} \\ \hline \end{array}$$

$$\begin{array}{r} 19. \quad 58 \text{ gal. } 2 \text{ qt. } 0 \text{ pt.} \\ \quad 17 \text{ gal. } 3 \text{ qt. } 1 \text{ pt.} \\ \hline \end{array}$$

$$\begin{array}{r} 20. \quad 83 \text{ bu. } 1 \text{ pk. } 4 \text{ qt.} \\ \quad 25 \text{ bu. } 0 \text{ pk. } 8 \text{ qt.} \\ \hline \end{array}$$

Solve:

21. A dairy had 46 gal. 1 qt. 1 pt. of milk on hand in the morning and sold 41 gal. 3 qt. 1 pt. How much was left?

22. A court is 100 yd. 2 ft. 9 in. long and 80 yd. 1 ft. 10 in. wide. By how much does the length exceed the width?

Multiplication

175. EXAMPLE: Find 7 times 12 rd. $2\frac{1}{2}$ ft.

$$\begin{array}{r} 12 \text{ rd. } 2\frac{1}{2} \text{ ft.} \\ \quad 7 \\ \hline \end{array}$$

$$\begin{array}{r} 84 \text{ rd. } 17\frac{1}{2} \text{ ft. or} \\ 85 \text{ rd. } 1 \text{ ft.} \end{array}$$

The product in the first column is $17\frac{1}{2}$ ft. This equals 1 rd. 1 ft. Hence we write 1 ft. and add 1 rd. to the result in the next column.

176. *To multiply compound denominate numbers, multiply each denomination separately and reduce the result, if necessary.*

WRITTEN EXERCISES

Multiply:

1. 18 lb. 10 oz. by 16:

6. 6 mi. 1250 ft. by 15.

2. 40 ft. 6 in. by 25.

7. 170 yd. 8 in. by 42.

3. 17 gal. 1 pt. by 32.

8. 40 gr. 11 doz. by 66.

4. 20 da. 6 hr. 10 min. by 50.

9. 120 ft. 7 in. by 33.

5. 10 wk. 3 da. 10 hr. by 12.

10. 40 T. 200 lb. by 100.

11. An automobile tank held 5 gal. 3 qt. 1 pt. of gasoline. How much gasoline did it take to fill the tank 6 times?

12. A driving track was 40 rd. 12 ft. 6 in. long. How far did a horse go in traveling over this track 9 times?

Division

177. EXAMPLE: Ralph divided 47 lb. 6 oz. of sand into 8 equal parts. How much did each part weigh?

Divide 47 lb. 6 oz. by 8.

$$\begin{array}{r}
 5 \text{ lb.} \quad 14\frac{3}{4} \text{ oz.} \\
 8 \overline{)47 \text{ lb.} \quad 6 \text{ oz.}} \\
 \underline{40} \\
 7 \times 16 = 112 \\
 \underline{118} \text{ oz.} \\
 8 \\
 \underline{38} \\
 32 \\
 \underline{6}
 \end{array}$$

(1) Dividing 47 lb. by 8 gives 5 lb. and 7 lb. remaining.

(2) 7 lb. is the same as $7 \times 16 \text{ oz.} = 112 \text{ oz.}$

(3) Adding this to 6 oz. makes 118 oz.

(4) Dividing 118 oz. by 8, we have $14\frac{3}{4} \text{ oz.}$

Each part weighed 5 lb. $14\frac{3}{4} \text{ oz.}$

178. *To divide a compound number by an abstract number, divide each denomination, beginning with the highest, and combine any remainder with the next lower denomination.*

WRITTEN EXERCISES

Divide:

- | | |
|-------------------------------------|--|
| 1. 120 ft. 8 in. \div 12. | 6. 262 yd. 2 ft. \div 6. |
| 2. 500 lb. 6 oz. \div 9. | 7. 90 rd. $4\frac{1}{2}$ ft. \div 8. |
| 3. 200 da. 17 hr. \div 15. | 8. 290 min. 40 sec. \div 7. |
| 4. 17 mi. 100 rd. \div 40. | 9. 18 A. 40 sq. rd. \div 20. |
| 5. 50 sq. ft. 80 sq. in. \div 24. | 10. 1 cu. ft. 500 cu. in. \div 27. |

Solve:

11. The fence around a square field measured 80 rd. 5 yd. 1 ft. 6 in. Find the length of one side.

12. There are 5 cans of equal size full of milk. The whole amount is 37 gal. and 2 qt. How much does each can hold?

13. A cement walk 15 rd. 3 yd. 1 ft. 8 in. extends across the front of 3 equal lots. What is the frontage of each lot?

179. EXAMPLE: How many iron bars 2 ft. 3 in. long can be cut from a rod 7 ft. 5 in. long?

Divide 7 ft. 5 in. by 2 ft. 3 in.

$$7 \text{ ft. } 5 \text{ in.} = 89 \text{ in.}$$

$$2 \text{ ft. } 3 \text{ in.} = 27 \text{ in.}$$

$$89 \text{ in.} \div 27 \text{ in.} = 3\frac{8}{27}.$$

3 bars can be cut from the rod and the remainder equals $\frac{8}{27}$ of a bar.

180. *To divide one compound number by another, reduce both to the same denomination and divide.*

WRITTEN EXERCISES

1. 90 ft. 9 in. \div 8 ft. 6 in.
2. 20 gal. 3 qt. \div 2 gal. 1 qt.
3. 40 bu. 2 pk. \div 3 bu. 6 qt.
4. 17 lb. 4 oz. \div 2 lb. 3 oz.
5. 45 yd. 2 ft. \div 1 ft. 10 in.
6. 48 gal. 1 pt. \div 18 gal.
7. 17 yd. 2 ft. \div 3 yd. 1 ft.
8. 2 sq. ft. 100 sq. in. \div 12 sq. in.
9. 75 rd. 12 ft. \div 3 rd. 10 ft.
10. 12 hr. 28 min. \div 5 hr. 20 min.
11. 24 A. 30 sq. rd. \div 4 A. 10 sq. rd.
12. 10 mi. 10 rd. \div 10 ft. 10 in.
13. 20 gal. 2 qt. \div 2 gal. 1 pt.
14. 7 wk. 2 da. 10 hr. \div 1 da. 20 hr.

Solve:

15. A grocer bought 4 bu. 3 pk. of strawberries and sold them 1 quart at a time. How many sales did he make?

16. How many times can a 1-quart tank be filled from 14 gal. 3 qt. of gasoline?

17. A square rug 110 in. on a side is how many feet around?

18. A car contained 4,950 lb. of coal. How many short tons on the car?

19. How many packages containing 2 lb. 12 oz. can be made from 30 lb. 4 oz. of starch?

20. A milkman has 54 gal. 1 qt. 1 pt. of milk and uses it to fill an equal number of quart-bottles and pint-bottles. How many of each can he fill?

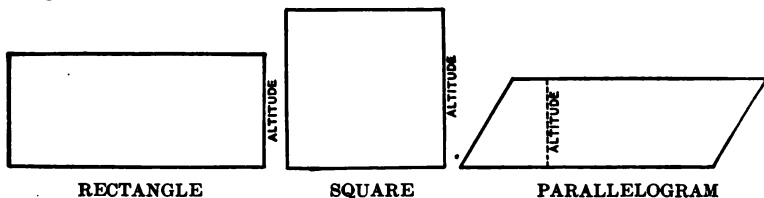
APPLICATIONS OF DENOMINATE NUMBERS

Measuring Surfaces

AREAS OF PARALLELOGRAMS

181. A **parallelogram** is a four-sided figure whose opposite sides are parallel, that is, everywhere an equal distance apart.

A **rectangle** is a four-sided figure whose angles are right angles.



A **square** is a rectangle whose sides are equal.

Squares and other rectangles are also parallelograms.

The side on which a figure seems to stand is called its **base**.

The height of a figure above its base is called its **altitude**.

In finding area, the base and the altitude must be of the same denomination, as feet and feet, or yards and yards.

182. *The number of units in the area of a rectangle or a parallelogram is the product of the numbers measuring its base and altitude.*

EXAMPLE: What is the area of a rectangle whose base is 1 ft. 6 in. and whose altitude is 8 in.?

Solution: (1) The base 1 ft. 6 in. = 18 in.

(2) $8 \times 18 \times 1$ sq. in. = 144 sq. in.

The base and the altitude expressed in inches are 18 in. and 8 in.; respectively. Hence the product of 8 and 18 is the number of square inches in the area of the rectangle.

WRITTEN EXERCISES

1. How many rectangular pieces of cardboard 9 in. by 12 in. can be cut from a piece a yard square?

Find the areas of parallelograms with the following bases and altitudes :

	2.	3.	4.	5.
Bases:	45 yd.	2.75 ft.	46 in.	315 ft.
Altitudes:	1.75 yd.	15 ft.	11.5 in.	.75 ft.

6. A village lot is 50 ft. by 120 ft. How many square feet in its area? How many square yards?

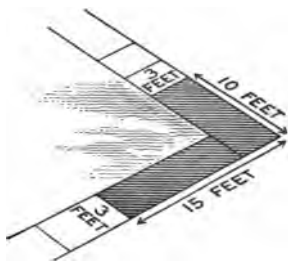
7. The *Place de la Concorde* in Paris is a rectangle 217 yd. by 357 yd. Find its area in square yards.

8. What is the altitude of a parallelogram that is 67.5 in. long and contains 135 sq. in.?

9. Find the area of the shaded portion of the walk shown in the picture.

10. How many acres in a farm in the shape of a rectangle that is 250 rd. long and 125 rd. wide?

11. What is the cost of laying a cement walk $75\frac{1}{2}$ ft. long and 6 ft. wide at \$.16 $\frac{1}{2}$ a square foot?



12. How many feet long is a rectangular park that contains 836,000 sq. yd. and is 1,425 ft. wide?

13. What is the cost of making a playground 75 ft. long, 40 ft. wide, at \$1.25 a square yard?

14. A skating pond in the form of a rectangle contained $\frac{1}{4}$ of an acre and was 4 rd. wide. How long was the pond?

15. How many square yards in a square court 100 ft. on a side?

16. A garage had a floor space 42 ft. wide and 84 ft. long. How many square feet in the floor?

AREA OF TRIANGLES

183. A triangle is a plane figure having three sides.

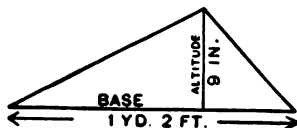
184. The number of square units in the area of a triangle is one-half of the product of the number of units measuring its base and altitude.

EXAMPLE: Find the area of a triangle whose base is 1 yd. 2 ft. and whose altitude is 9 inches.

Solution: (1) 1 yd. 2 ft. = 5 ft.

(2) 9 in. = $\frac{3}{4}$ ft.

(3) $\frac{1}{2} \times \frac{3}{4} \times 5 \times 1$ sq. ft. = $1\frac{1}{4}$ sq. ft.

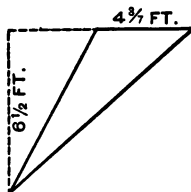
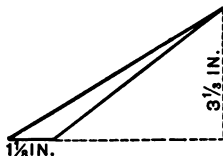
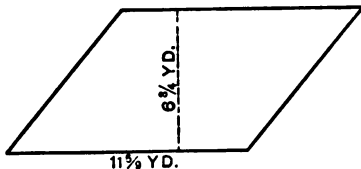
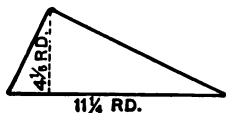


WRITTEN EXERCISES

Find the area of each triangle :

	1.	2.	3.	4.
Base.....	3 in.	9 ft.	$2\frac{1}{2}$ yd.	6 ft.
Altitude.....	4 in.	3 ft.	1 yd.	$3\frac{1}{2}$ ft.

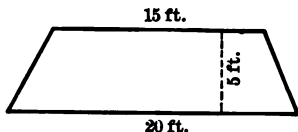
5. Find the area of each of the following figures:



6. A triangular plot of ground had a base of 20 rd. and an altitude of 16 rd. How many acres in its area?

AREA OF TRAPEZOIDS

185. A trapezoid is a plane figure of four sides, two sides of which, and only two, are parallel.



186. The number of square units of area in a trapezoid is one-half the product of the number of units in the altitude and in the sum of the lengths of the bases.

EXAMPLE: Find the area of a trapezoid whose parallel bases are 15 ft. and 20 ft., and whose altitude is 5 ft.

Solution: (1) $15 \text{ ft.} + 20 \text{ ft.} = 35 \text{ ft.}$

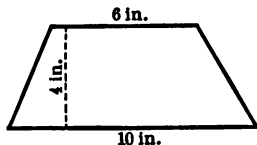
(2) $\frac{1}{2} \times 5 \times 35 \times 1 \text{ sq. ft.} = 87.5 \text{ sq. ft.,}$ the area of the trapezoid.

WRITTEN EXERCISES

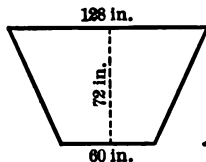
1. Let s represent the sum of the two parallel sides of a trapezoid, and a its altitude. What stands for its area?

Find the areas of the following trapezoids:

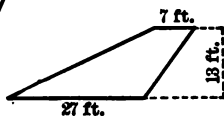
2.



3.

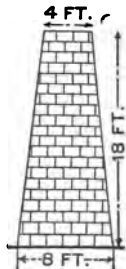


4.



5. A field is in the form of a trapezoid. The parallel sides are 116 yd. and 84 yd., and the distance between them is 50 yd. How much will it cost to plow it and sow it with wheat at 6 cts. per 10 sq. yd?

6. What will the stone for the wall in the figure cost at 97 cts. per square foot of the face?



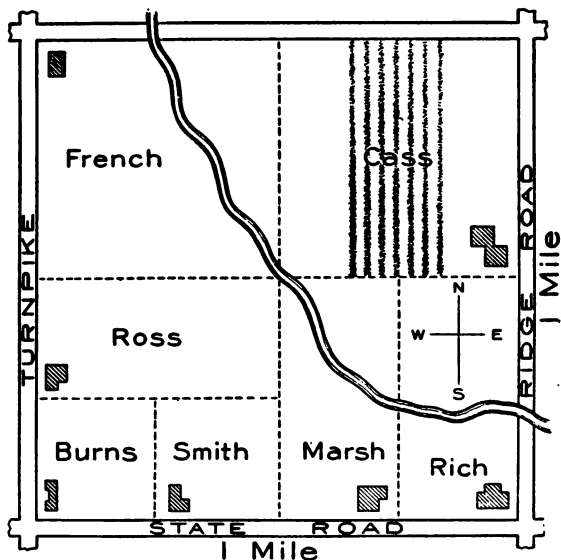
Find the area of each of the following trapezoids :

	LOWER BASE.	UPPER BASE.	ALTITUDE.	AREA.
7.	23 ft.	17 ft.	12 ft.	()
8.	72 in.	28 in.	20 in.	()
9.	25 yd.	25 yd.	12 yd.	()
10.	32 rd.	48 rd.	9 rd.	()

11. What is the area of a trapezoid of bases 8 in. and 6 in. and of altitude 4 in.?

MEASURING LAND

ORAL EXERCISES



1. How many miles are there in the distance around the tract of land as shown in the picture? How many rods are there in this distance (1 mi. = 320 rd.)?

2. The land is divided into fourths, eighths, and sixteenths. What part of the whole is each farm? How many rods are there in the length of the Cass farm? In its breadth?

3. How many rods of line-fence are there between the Cass and French farms? Between the Cass and Rich farms?

4. What part of the square mile does the Cass farm occupy? The Rich farm? The Ross farm? The Smith farm?

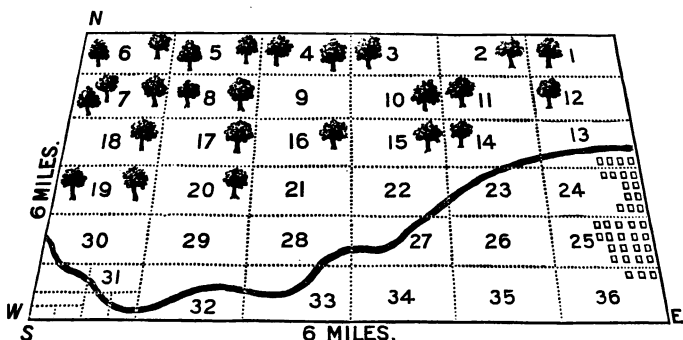
187. A square mile of land contains 640 acres and is called by surveyors a **section**.

ORAL EXERCISES

1. How many acres are there in the French farm? In the Smith farm? In the Burns farm?

2. Which of the above farms occupy a quarter-section?

3. From the dimensions in rods of the Smith farm find its area in square rods. How many acres does it contain? How many square rods are there in an acre?



188. In surveying the newer states, the government surveyors divided the land into **townships** as nearly as possible 6 miles square. Each township is divided into 36 parts called **sections**, and these are recorded by number as shown in the figure. The township is regarded as square for all computations.

EXERCISES

1. How many square miles are there in a township?
2. In every township the Government sets apart section number 16 for school purposes. How many acres is this? In a locality where such land sells for \$25 an acre, what is the gift worth?
3. Section 31 is the one shown on p. 140. What part of the area of a township is this section? How many acres are there in a township?
4. How many acres are there in a row of sections in a township?
5. What will be the cost of a line-fence between section 9 and section 10 at \$1.75 a rod?
6. If half of a township is timber land worth \$10 an acre, and the rest is farming land worth \$25 an acre, what is the value of the township?
7. Make and solve 3 other problems about land.

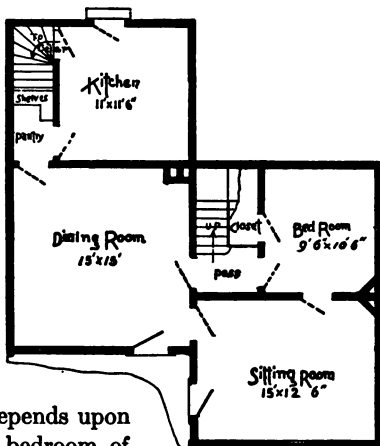
CARPETING, PAPERING, AND SHINGLING**WRITTEN EXERCISES**

1. A certain room is 5 yd. long and 4 yd. wide. How many strips of carpet 1 yd. wide, and running the long way, will be required to cover the room? How many yards of carpet will there be?
2. In carpeting the sitting-room shown in the floor plan on p. 143, the strips are to run lengthwise, and 8 in. to the strip is to be allowed for matching the pattern. It is not customary in selling carpet to cut strips lengthwise, but a fraction of a yard in length is sold. Make a drawing of the sitting-room floor showing the strips of carpet.
3. How many yards of carpet $\frac{3}{4}$ yd. wide will be required to carpet the sitting-room, if the strips run the long way of the room?

4. How many yards of carpet 1 yd. wide, that can be matched without waste, are needed to carpet the bedroom if the strips run the long way?

5. A rug 9 ft. by 12 ft. is placed centrally in the dining-room, and yard-wide filling at $33\frac{1}{2}$ cts. per yard is used to cover the rest of the floor. What is the cost of the filling?

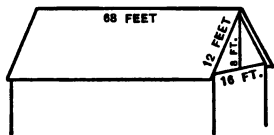
Wall-paper is usually sold in rolls of 16 yd. each, the paper being 18 in. wide. Fractions of a roll are not sold. The number of strips that can be cut from a roll depends upon matching the pattern. In the bedroom of the above house the ceiling paper is to run the short way, 5 strips being cut from a roll. In the other rooms the ceiling paper is cut so as to use 3 sixteen-foot strips to the roll.



6. Find the cost of the paper for the ceilings of the bedroom, dining-room, and sitting-room at 40 cts. a roll.

7. Taking the height of the rooms to be 9 ft., 5 strips can be cut from a roll. Allowing $\frac{1}{10}$ of the measured surface for doors, windows, baseboards, and frieze, find the cost of the paper for the three rooms, at 45 cts. a roll.

8. How many shingles will be needed to cover a roof 42 ft. along the ridge and 18 ft. down the slope, allowing 800 shingles per 100 sq. ft.?



9. Shingles are sold in bundles, 4 bundles to the thousand, and a fraction of a bundle is not sold. Find the cost of the shingles actually used for

the roof in the figure at \$2.45 per thousand shingles and for the two gables at \$3.80 per thousand.

Measuring Volume

VOLUMES OF RECTANGULAR SOLIDS

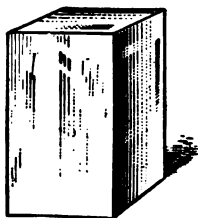
189. *The number of cubic units in the volume of a rectangular solid, or prism, is the product of the numbers of units in its base and altitude.*

The area of the base must be expressed in square units corresponding to the linear units of the altitude.

EXAMPLE : Find the volume of a rectangular box whose base is 50 sq. in. and whose altitude is $1\frac{1}{4}$ ft.

Solution : (1) $1\frac{1}{4}$ ft. = 15 in.

(2) $15 \times 50 \times 1$ cu. in. = 750 cu. in.



WRITTEN EXERCISES

1. An ice-wagon has a bed 10 ft. 6 in. by 3 ft. 9 in., inside measure, and the ice is packed 4 ft. 2 in. high. How many cubic feet of ice are there?

2. A street 40 ft. wide and $\frac{3}{4}$ mi. long is to be covered with crushed stone to a depth of 3 in. Find the cost of the stone at \$1.45 per cubic yard.

3. How many wagon-loads will the quantity of stone mentioned in Exercise 2 make, if the inside measurements of the wagon are $4\frac{1}{2}$ ft. by $9\frac{1}{2}$ ft. by $2\frac{1}{4}$ ft.?

4. How many cubic feet of asphalt are required to cover a surface 2 yd. wide and 500 ft. long with a layer 3 in. thick?

5. How many cubic feet of material are there in a cement walk 450 ft. long, $4\frac{1}{2}$ ft. wide, and 6 in. thick?

6. How many cubic yards of masonry in a concrete dam 350 ft. long, 12 ft. thick, and 36 ft. high?

7. A tunnel 1000 ft. long, 30 ft. wide, 15 ft. high, was cut through rock. How many cubic feet of rock were removed?

EQUIVALENTS

190. Cubic contents may be expressed in units of capacity.

$$\begin{aligned}231 \text{ cu. in.} &= 1 \text{ gallon.} \\2,150.42 \text{ cu. in.} &= 1 \text{ bushel.}\end{aligned}$$

191. EXAMPLE: An automobile has a gasoline tank measuring 3 ft. by 14 in. by 8 in. How many gallons will it hold?

Solution: (1) 3 ft. = 36 in.

(2) $36 \times 14 \times 8$ cu. in. = 4,032 cu. in.

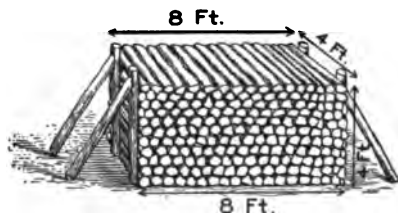
(3) $4,032 \text{ cu. in.} \div 231 \text{ cu. in.} = 17\frac{4}{11}$, the number of gallons.

WRITTEN EXERCISES

1. How many cubic inches in a liquid quart?
2. How many cubic inches in a dry quart?
3. Which is the larger, the dry or the liquid quart? By how many cubic inches?
4. How many cubic feet in a bushel?
5. How many bushels does a bin hold that is 8 ft. by 4 ft. by 6 ft.?
6. A bin measures 4 ft. by $6\frac{1}{2}$ ft. by $3\frac{1}{2}$ ft. and is filled with oats. How many times can a horse be fed 4 qt. of oats from the contents of the bin? (Neglect remainder.)
7. The tank on a gasoline stove was 16 in. long, 6 in. wide, and 4 in. deep. How many times could it be filled from a 10-gallon tank of oil? (Neglect remainder.)
8. A water tank held 500 gal. of water when full. What was its volume in cubic feet?
9. A tank is $28\frac{1}{2}$ in. long, $6\frac{1}{8}$ in. wide, and $8\frac{1}{2}$ in. deep. How many cubic inches does it contain? How many gallons?
10. How many bushels of grain does a bin hold that is $12\frac{1}{2}$ ft. long, $8\frac{1}{4}$ ft. wide, and 4 ft. deep?

MEASURING WOOD AND LUMBER

192. The picture shows a cord of wood (see page 127).



ORAL EXERCISES

1. How many cubic feet are there in a cord of wood?
2. How many cords of wood are there in a pile 32 ft. long, 4 ft. wide, and 4 ft. high? In a pile 32 ft. by 4 ft. by 2 ft.?
3. How many cords of wood are there in 12 rows of 4-foot sticks, each row being 32 ft. long and 4 ft. high?
4. How many cords of wood are there in a pile 64 ft. long and 10 ft. high?
5. How many stove lengths (see page 127) can be cut from one 4-foot length?
6. What are the measurements of a cord of stove wood?

Wood is usually sold at the wood-yard in this form. Thus, if a dealer says maple wood is \$2.50 a cord, he means a cord of stove wood.

WRITTEN EXERCISES

1. How many cords of 16-inch stove wood can be cut from a cord of 4-foot wood?
2. How many cords of 4-foot wood are required to cut 75 cords of 16-inch wood? 96 cords? 69 cords? 243 cords?
3. A dealer buys 4-foot wood at \$4 a cord and, after cutting it into 16-inch wood, sells it for \$2.50 a cord. How much does he gain on a cord of the 4-foot wood?

193. A square foot of lumber 1 in. or less in thickness is called a **board foot**. In lumber more than 1 in. thick, the number of board feet depends upon the thickness.

Thus, a board 8 in. wide, 3 ft. long, and $\frac{1}{2}$ in. thick contains 2 board feet.

8 in. - $\frac{1}{2}$ ft. Lumber $\frac{1}{2}$ in. thick is reckoned as if it were 1 in. thick.
 $\frac{1}{2} \times 3 \times 1$ board ft. = 2 board ft.

A board 8 in. wide, 3 ft. long, and $1\frac{1}{2}$ in. thick contains 3 board feet.
 $\frac{3}{4} \times 3 \times 1\frac{1}{2}$ board ft. = 3 board ft.

WRITTEN EXERCISES

How many feet of lumber are there in :

1. 3 boards each 16 ft. long, 10 in. wide, and 1 in. thick?
2. 12 planks each 12 ft. long, 14 in. wide, and 2 in. thick?
3. 150 boards each 14 ft. long, 16 in. wide, and $\frac{3}{4}$ in. thick?
4. 25 joists each 16 ft. long, 4 in. wide, and 4 in. thick?

Find the cost of the following at \$22 per thousand board feet :

	FEET LONG.	INCHES WIDE.	INCHES THICK.
5. 28 boards.....	16	$10\frac{1}{2}$	$\frac{1}{2}$
6. 52 boards.....	14	14	1
7. 65 scantlings...	16	4	2
8. 48 joists.....	14	10	$2\frac{1}{2}$
9. 12 timbers.....	$18\frac{1}{2}$	12	10
10. 125 rafters.....	20	6	2
11. 36 plates.....	$16\frac{1}{2}$	8	$4\frac{1}{2}$

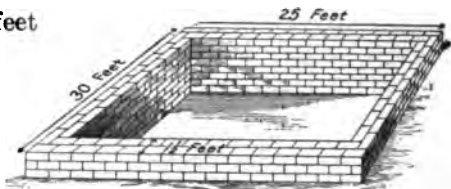
Solve :

12. How many feet of lumber in a box, excluding the top, made of boards $\frac{3}{4}$ in. thick, and having a bottom 6 ft. by $3\frac{1}{2}$ ft. and an inside depth of $4\frac{1}{2}$ ft.?

13. How many feet of lumber are required to lay a floor 16 ft. wide and 80 ft. long, of planks $3\frac{1}{2}$ in. thick?

COMPUTING THE CONTENTS OF MASONRY

194. EXAMPLE: Find the number of cubic feet of stone in a cellar wall 25 ft. by 30 ft. outside measurement and $1\frac{1}{2}$ ft. thick and 8 ft. deep.



Solution: (1) Take the end walls to be 25 ft. long, $1\frac{1}{2}$ ft. thick, and 8 ft. deep.

Then $25 \times 8 \times 1\frac{1}{2} \times 1$ cu. ft. = 300 cu. ft.

The two end walls = 2×300 cu. ft. = 600 cu. ft.

(2) Take the side walls to be 27 ft. long, $1\frac{1}{2}$ ft. thick, and 8 ft. deep.

Then $27 \times 8 \times 1\frac{1}{2} \times 1$ cu. ft. = 324 cu. ft.

The two side walls = 2×324 cu. ft. = 648 cu. ft.

(3) Therefore, the number of cubic feet in the cellar wall is 600 cu. ft. + 648 cu. ft. = 1,248 cu. ft.

WRITTEN EXERCISES

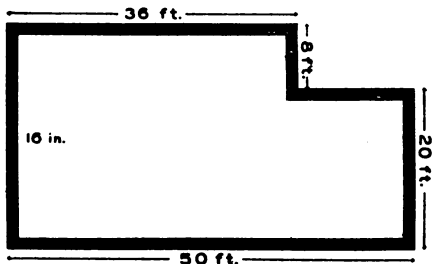
1. At \$1.56 per cubic yard, what is the cost of the stone for a wall $1\frac{1}{2}$ ft. thick, built within a cellar 30 ft. by 40 ft. and 7 ft. deep?

2. Find how many cubic yards of masonry there are in a foundation wall in the form of a rectangle whose inside dimensions are 30 ft. by 50 ft. and 9 ft. high, and whose thickness is 18 in. Draw a ground-plan of the wall.

3. The inside dimensions of a hollow brick pier are 15 ft. long, 12 ft. wide, and 7 ft. high. How many cubic feet in the wall which is 8 in. thick?

4. How many cubic yards of stone in the walls of a basement, the inside dimensions of which are 100 ft. by 75 ft. by 12 ft., the wall being 20 in. thick?

5. Find the number of cubic yards of masonry in a wall 9 ft. high built on the foundation shown in the picture.



6. A cistern in the form of a hollow prism has for inside dimensions, length 16 ft., width 5 ft., depth 7 ft. Taking the top to be flat and the thickness of the walls of the cistern including the top and bottom to be 8 in., find the number of cubic feet of cement used in making the cistern.

7. A vat built of bricks and mortar had for inside dimensions, length 10 ft., width 8 ft., depth 12 ft. Taking the thickness of the wall to be 6 in., compute the number of cubic feet in the masonry, omitting the top and the bottom.

8. A glass cube 12 in. on an edge has a hollow cubical space within, 6 in. on an edge. How many cubic inches of glass are there?

Finding the Difference Between Dates

ORAL EXERCISES

1. How many days are there from January 1 to February 25, including Jan. 1, but excluding Feb. 25?

2. How many days are there from April 1 to May 20, including April 1, but excluding May 20?

3. Longfellow was born June 18, 1819, and Lowell was born Feb. 22, 1819. What was the difference in their ages?

4. How long after the beginning of the American Revolution, April 19, 1775, did the French Revolution, May 5, 1789, begin?

5. The Spanish-American War began April 21, 1898, and ended April 11, 1899. How long did it last?

195. When the difference in time is large, the following written method of solution should be used :

EXAMPLE: How long after the Battle of Hastings, Oct. 14, 1066, did the Battle of Waterloo, June 18, 1815, take place?

Solution :

	YR.	MO.	DA.
June 18, 1815 - 1815	6	18	
Oct. 14, 1066 - 1066	<u>10</u>	<u>14</u>	
	748 yr.	8 mo.	4 da.

196. To find the difference between dates of different years, write the year, the number of the month, and the days in each date and subtract.

WRITTEN EXERCISES

1. Victoria was born May 24, 1819, and was crowned queen, June 28, 1836. How old was she at this time?

2. Napoleon was born Aug. 15, 1769, and died May 5, 1821. What was his age at the time of his death?

3. George Washington was born Feb. 22, 1732, and died Dec. 14, 1799. What was his age at the time of his death?

4. Queen Elizabeth was born Sept. 7, 1533, and died March 24, 1603. How old was she at the time of her death?

5. The British Museum celebrated its 150th anniversary in 1909. In what year was it founded?

6. Abraham Lincoln was born Feb. 12, 1809, and died April 14, 1865. How old was he when he died?

7. How many years, months, and days is it from the discovery of America to the present day?

8. How many years, months, and days is it since the battle of Lexington, April 19, 1775?

9. The Declaration of Independence was adopted July 4, 1776. How long ago was that?

10. How long is it since the Boston massacre, which occurred March 5, 1770?

REVIEW

WRITTEN EXERCISES

Add :

$$\begin{array}{r} 1. \ 40 \text{ gal. } 2 \text{ qt. } 1 \text{ pt.} \\ \quad 86 \text{ gal. } 3 \text{ qt. } 1 \text{ pt.} \\ \hline \end{array}$$

$$\begin{array}{r} 3. \ 2 \text{ mi. } 10 \text{ rd. } 100 \text{ ft. } 6 \text{ in.} \\ \quad 5 \text{ mi. } 40 \text{ rd. } 63 \text{ ft. } 9 \text{ in.} \\ \hline \end{array}$$

$$\begin{array}{r} 2. \ 12 \text{ bu. } 3 \text{ pk. } 2 \text{ qt. } 1 \text{ pt.} \\ \quad 15 \text{ bu. } 2 \text{ pk. } 7 \text{ qt. } 1 \text{ pt.} \\ \hline \end{array}$$

$$\begin{array}{r} 4. \ 17 \text{ T. } 1000 \text{ lb. } 8 \text{ oz.} \\ \quad 25 \text{ T. } 1500 \text{ lb. } 11 \text{ oz.} \\ \hline \end{array}$$

$$\begin{array}{r} 5. \ 48 \text{ sq. yd. } 8 \text{ sq. ft. } 100 \text{ sq. in.} \\ \quad 36 \text{ sq. yd. } 3 \text{ sq. ft. } 106 \text{ sq. in.} \\ \quad 17 \text{ sq. yd. } 7 \text{ sq. ft. } 54 \text{ sq. in.} \\ \hline \end{array}$$

$$\begin{array}{r} 6. \ 100 \text{ cu. yd. } 20 \text{ cu. ft. } 12 \text{ cu. in.} \\ \quad 276 \text{ cu. yd. } 12 \text{ cu. ft. } 1720 \text{ cu. in.} \\ \quad 106 \text{ cu. yd. } 15 \text{ cu. ft. } 200 \text{ cu. in.} \\ \hline \end{array}$$

Subtract :

$$\begin{array}{r} 7. \ 16 \text{ mi. } 1000 \text{ ft. } 11 \text{ in.} \\ \quad 7 \text{ mi. } 968 \text{ ft. } 10 \text{ in.} \\ \hline \end{array}$$

$$\begin{array}{r} 9. \ 12 \text{ bu. } 3 \text{ pk. } 2 \text{ qt. } 1 \text{ pt.} \\ \quad 3 \text{ bu. } 3 \text{ pk. } 7 \text{ qt. } 1 \text{ pt.} \\ \hline \end{array}$$

$$\begin{array}{r} 8. \ 700 \text{ T. } 409 \text{ lb. } 3 \text{ oz.} \\ \quad 80 \text{ T. } 1500 \text{ lb. } 9 \text{ oz.} \\ \hline \end{array}$$

$$\begin{array}{r} 10. \ 40 \text{ gal. } 2 \text{ qt. } 0 \text{ pt.} \\ \quad 17 \text{ gal. } 3 \text{ qt. } 1 \text{ pt.} \\ \hline \end{array}$$

Multiply :

$$\begin{array}{r} 11. \ 16 \text{ sq. yd. } 3 \text{ sq. ft. } 100 \text{ sq. in.} \\ \quad \quad \quad 7 \\ \hline \end{array}$$

$$\begin{array}{r} 12. \ 10 \text{ cu. yd. } 20 \text{ cu. ft. } 1000 \text{ cu. in.} \\ \quad \quad \quad 25 \\ \hline \end{array}$$

Divide :

$$13. \ 15 \overline{)25} \text{ sq. yd. } 8 \text{ sq. ft. } 100 \text{ sq. in.}$$

$$14. \ 22 \overline{)17} \text{ mi. } 1000 \text{ yd. } 2 \text{ ft.}$$

15. From the dimensions given in the figure, find the area of the space covered by the poultry-house.

16. Find the number of square feet of lumber required for the walls, the front opening being 20 ft. wide. Also for the roof, taking the length of the roof to be 40 ft.

17. How many yards of wire netting 1 yd. wide are required to cover the opening to the shed?

18. How many flagstones 2 ft. 8 in. by 5 ft. are required to lay a walk 5 ft. wide and 56 ft. long?

19. How many acres are there in a farm $1\frac{1}{2}$ mi. long and $\frac{3}{4}$ of a mile wide?

20. What is the cost of renovating a rug $8\frac{1}{2}$ ft. \times $10\frac{1}{2}$ ft. at 10 cts. per square yard?

21. How many feet of inch boards will be necessary to build a sign-board 40 ft. long and 12 ft. high? What will the lumber cost at \$6 per thousand feet?

22. What is the volume of a rectangular solid having a square base 8 in. on a side and an altitude of 10 in.?

23. A rectangular stone pier has a base of 25 sq. yd. and a height of 35 ft. What is the number of cubic feet in its volume? What was the cost of the pier at \$8.50 per cu. yd.?

24. Air is composed of oxygen and nitrogen; in any quantity of pure air about .21 is oxygen and .79 is nitrogen. How many cubic feet of each are there in 2,700 cu. ft. of air?

25. If the average amount of air inhaled by a pupil at one breath is 24 cu. in., how many times must he breathe to inhale 1 cu. ft.? If he breathes 20 times a minute, how long will it take him to inhale a cubic foot?

26. How long will it take 30 pupils to inhale as much air as there is in a schoolroom 25 ft. by 30 ft. by 12 ft.?

27. A vat is 20 ft. long, $3\frac{1}{4}$ ft. deep, and 6 ft. wide. How many gallons of paper pulp will it hold when full?

28. An elevator has a capacity of 250,000 bu. of grain. How many cubic feet in the cubical capacity of its bins?

29. A freight car is 32 ft. long, $7\frac{1}{2}$ ft. high, and 8 ft. wide inside measure. How many bushels of wheat would it contain?

30. How many cords of wood in a pile 256 ft. long, 4 ft. wide, and 16 ft. high?

31. How many yards of carpet $\frac{3}{4}$ yd. wide are required to cover a room 15 ft. by 18 ft., the strips running the long way and $\frac{7}{8}$ yd. in all being allowed for matching?

32. How many seconds in a day of 24 hours?

33. How many minutes in an angle of 35° ?

34. Find the volume of an oblong solid whose base is 15 sq. ft. and whose altitude is 50 ft.

35. The edge of a cube is $4\frac{1}{2}$ in. How many cubic inches does it contain?

36. How many cubic feet are there in a rectangular solid whose edges are $1\frac{1}{2}$ ft., $2\frac{3}{4}$ ft., and $3\frac{1}{2}$ ft.?

37. The dimensions of a box are $14\frac{3}{4}$ in., $12\frac{3}{4}$ in., and $3\frac{1}{4}$ in. How many cubic inches does it contain?

38. Some freight-cars have their measurements in feet and inches stamped on them. How many cubic feet in the contents of each car, as given?

	(1)	(2)	(3)	(4)	(5)
Length.....	33 — 9	50 — 0	44 — 0	33 — 10	34 — 0
Width.....	6 — 2	9 — 4	8 — 6	8 — 1	8 — 6
Height.....	7 — 0	8 — 10	8 — 7	7 — 1	8 — 0

Plan the work, cancel when possible, and find the results within 1 cu. ft., but not exceeding the actual capacity of the cars.

CHAPTER V

THE SOLUTION OF PROBLEMS

197. The following shows the *four steps* used in solving a problem:

EXAMPLE : Find the altitude of a rectangle whose base is 8 in. and whose area is 152 sq. in.

(1) *Read* carefully, noting that the base and the area of a rectangle are given, and that the altitude is required.

(2) *Plan :* Recall that the area of a rectangle is the product of the numbers expressing its length and breadth. Hence 152 is 8 times the required number and must be divided by 8.

(3) *Computation :*
$$\begin{array}{r} 19 \\ 8 \overline{)152} \end{array}$$

(4) *Test :* $8 \times 19 = 152.$

THE FOUR ESSENTIALS

1. **Read the problem ;** note carefully what is given and what is required.

2. **Plan the work ;** determine how to find what is required from what is given.

3. **Make the computations** as planned.

4. **Test the result.**

Make the planning of a problem a distinct and important feature of its solution. In very simple problems, the plan and the work need not be separated, but any uncertainty as to *how* a problem is to be worked shows clearly that a separate, correct plan is necessary. NEVER WORK AT RANDOM.

WRITTEN EXERCISES

Plan the solution ; do not make the computation :

1. How many feet per minute is a train moving when traveling 42 mi. per hour?

2. A train left Cincinnati at 8:15 A.M. and arrived at St. Paul, 702 mi. distant, at 2:57 A.M. the next day. Find its average speed in miles per hour.

3. The base of a rectangle is 16 in., its area is 3 sq. ft. Find the altitude in inches.

4. A man earns \$75 a month. He spends \$10 per month for room rent, \$3.50 per week for board, \$125 per year for clothing and other expenses. In how many years will he save \$1000 at this rate?

5. 40 ft. of wire weighed 1 lb. What was the weight of 31 mi. of this wire?

6. A, B, and C own a store; A owns $\frac{1}{4}$ of it, and B owns $\frac{1}{2}$ as much as A. What part does C own?

7. The base of a rectangle is 17 in.; its perimeter is 48 in. What is its altitude?

8. A 100-acre farm contains 4 lots. Three of the lots contain $55\frac{1}{2}$ acres, $20\frac{3}{4}$ acres, and $7\frac{5}{8}$ acres respectively. How many acres does the fourth lot contain?

Plan and solve :

9. $\frac{3}{5}$ of the distance from Detroit to Chicago is 190 mi. What is the whole distance?

Plan : (1) $\frac{1}{5}$ of the distance = $\frac{1}{5}$ of 190 mi., or () mi.

(2) $\frac{3}{5}$, or the whole distance, = 3×95 mi. = () mi.

10. A dressmaker paid \$1.40 for $\frac{1}{3}$ of a yard of velvet. What was the price per yard?

Plan : (1) $\frac{1}{3}$ yd. cost $\frac{1}{3}$ of \$1.40, or \$().

(2) $\frac{2}{3}$ yd., or 1 yd., cost $2 \times \$1.40 = ()$.

11. When 13 ounces of cinnamon cost \$.65, what is the cost of cinnamon per pound?

12. In 1900, $\frac{1}{3}$ of the population of the United States was 10 millions. Find the population.

13. \$24 is $\frac{3}{4}$ of the cost of a wagon. What is its cost? What is $\frac{1}{4}$ of its cost?

14. $\frac{1}{3}$ of a ton of coal costs \$7.35. What is the cost of a ton? Of $\frac{1}{2}$ of a ton?

15. $\frac{3}{4}$ of the number of passengers on a street-car is 12. How many are there in the car?

16. $\frac{1}{17}$ of the population of Chicago in a certain year was 500,000. What was the population?

17. $\frac{3}{20}$ of the population of Pittsburg in a certain year was 48,000. What was the population? What was $\frac{1}{4}$ of it?

18. $\frac{1}{3}$ of the total newspaper product in the United States in a recent year was 60,000 tons. What was the total product?

19. At a concert $\frac{1}{11}$ of the audience sat on the main floor, and 360 in the gallery. How many people were there in all?

20. 300 men march 4 abreast in ranks 6 ft. apart. How long is the procession that they form?

UNITARY ANALYSIS

198. Problems are often solved by a method called unitary analysis.

EXAMPLES:

1. When 16 books cost \$5.12, what is the cost of 9 at the same rate?

Plan: (1) Since 16 books cost \$5.12, 1 book will cost $\frac{1}{16}$ of \$5.12.

(2) 9 books will cost 9 times as much as 1 book, or
 $9 \times \frac{1}{16}$ of \$5.12.

Computation: (1) $\$5.12 \div 16 = \$.32$.

(2) $9 \times \$.32 = \2.88 .

In this solution we first found the cost of 1 book, from which we found the cost of 9. The plan of solving a problem by making a unit the basis of calculation is the essential feature of unitary analysis.

2. Find the cost of 150 ft. of wire netting at 38 cts. per 100 ft.

Plan : (1) Since the price is quoted per 100 ft., this is taken as the unit of computation.

(2) There are as many 100-ft. lengths in 150 ft. as 100 is contained times in 150.

(3) Since a 100-foot length costs \$.38, the whole will cost \$.38 multiplied by the number of 100-foot lengths.

Computation : (1) $150 \text{ ft.} \div 100 \text{ ft.} = 1\frac{1}{2}$.

(2) $$.38 \times 1\frac{1}{2} = $.57.$

WRITTEN EXERCISES

In the following problems write out the plan, or analysis, and make the computation in steps, as in the examples above.

1. When 12 yd. of broadcloth cost \$27.60, what is the cost of 17 yd. at the same rate?

2. When 45 hats cost \$135, what is the cost of 2 dozen at the same rate?

3. $\frac{3}{4}$ of the production of book paper in a recent year was 100,500 tons. What was the total product?

Suggestion : 1 fourth of the production is the unit quantity to be found first.

4. $1\frac{1}{4}$ of the total product of writing-paper in a recent year was 100,000 tons. What was the total product?

5. Wire netting comes in rolls of 150 ft. each. When only unbroken rolls are sold, how many rolls must be bought to make a fence 575 ft. long? What is the cost at 50 cts. per roll?

6. A man wishes to fence a rectangular lot 50 ft. by 115 ft. with netting at 40 cts. a 100-ft. roll. If broken rolls are not sold, how much must he pay for the netting?

7. A dealer received a special price of 90 cts. a copy on books bought in lots of 500 each. During the season he purchased 4,500 copies in this way. How much did the books cost him?

8. A real estate company sold $\frac{1}{4}$ of a tract of farm land for \$35,000. At this rate how much was the whole block worth?

9. $\frac{1}{4}$ of a man's yearly income was \$1,800. What was the whole of his yearly income?

APPROXIMATING RESULTS

199. Before solving a problem *make a rough estimate of the result.* The habit of doing this will prevent the errors that would result from working at random.

ORAL EXERCISES

1. A rectangle is 12 in. long and 6.5 in. wide. Is its area greater or less than 72 sq. in.? Why? Is its area greater or less than 84 sq. in.? Why?

2. A rectangle is 5.5 ft. wide and 11.3 ft. long. Is its area greater or less than 55 sq. ft.? Why? Is its area greater or less than 72 sq. ft.? Why?

3. What is the cost of 15 lb. of sugar at $5\frac{1}{4}$ cts. a pound? Is the cost more or less than 75 cts.? Why? Is it more or less than 90 cts.? Why?

4. A train runs from New York to Montreal, 383 miles, in 12 hours. Estimate the rate of speed per hour.

5. What is the cost of 11 yd. of cloth at 29 cts. a yard? How would you estimate the result?

6. What is the cost of a gross of paste-bottles at 9 cts. each? How would you estimate the result?

7. What is the area of a triangle 22 in. long and 19 in. wide? How would you estimate the result?

WRITTEN EXERCISES

Estimate the results and then solve :

1. A rectangular box is 8 ft. by 4 ft. by $5\frac{1}{2}$ ft. Find its volume.
2. What is the area of a triangle of base 6.5 in. and altitude 14.5 in.?
3. What is the area of a rectangle of base $5\frac{1}{2}$ yd. and altitude $3\frac{1}{2}$ yd.?
4. When bottles of ink cost \$15.12 per gross, what is the cost per bottle?
5. When bottles of library paste cost \$5.04 per gross, what is the cost per bottle?
6. A crate of eggs contains 6 layers of 6 dozen each. How many eggs are there in the crate?
7. What is the cost of two 16-quart crates of blueberries at 8 cts. a quart?
8. How many hours does it take a train to travel 440 mi. at the rate of 35 mi. an hour?

200. A close approximation of the result is often all that is required in solving a business problem.

ORAL EXERCISES

1. What is the cost of 3 yd. of muslin at $12\frac{1}{2}$ cts. a yard? How much does a customer who makes this purchase pay for the cloth?
2. What is the cost of $8\frac{3}{4}$ yd. of ribbon at 10 cts. a yard? How much does a customer who makes this purchase pay for the ribbon?
3. How much does a customer pay for $8\frac{1}{4}$ lb. of rice at 9 cts. a pound?
4. If the computed cost of an article is $\$.37\frac{1}{2}$, what is the amount usually paid for it?

5. One cent is what part of a dollar? To how many decimal places need the value of anything be expressed to show its value correct "to the nearest cent."

In determining results to the nearest cent, all decimal places beyond the third are useless and should not be calculated.

WRITTEN EXERCISES

1. On a certain railroad, the distance from New York to Chicago is 1,024 mi. and the fare is \$17. How much is this per mile correct to the nearest tenth of a cent?

2. The cost of operating a railway has been classified thus:

Cost of maintenance of way, .2733 of the operating expenses.

Cost of maintenance of equipment, .1551 of the operating expenses.

Conducting transportation, .5284 of the operating expenses.

General expenses, .0432 of the operating expenses.

In one year the operating expenses of the Missouri Pacific railway were \$10,500,000. How would the sum be distributed under the above heads? Find the results correct to the nearest \$1000.

Suggestion: To find the cost of maintenance of way, we find:

$$\begin{aligned} & .2733 \times \$10,500,000 \\ & - 2733 \times \$1,050 \\ & - \$2,869,650 \\ & - \$2,870,000 \text{ to the nearest } \$1000. \end{aligned}$$

RATIO

201. PREPARATORY.

1. What part of 9 qt. are 2 qt.? 5 qt.? 3 qt.? 7 qt.?
2. What part of 10 bu. are 2 bu.? 4 bu.? 5 bu.? 8 bu.?
3. What fraction of 7 days are 2 days? 3 days? 5 days? 6 days?
4. What fraction of 1 square foot is 1 sq. in.? What fraction are 12 sq. in.? 36 sq. in.? 72 sq. in.?

5. What part of $\frac{1}{17}$ is $\frac{1}{17}$? What part of $\frac{1}{17}$ is $\frac{4}{17}$?
 6. What fraction of \$1 is $16\frac{3}{4}$ cts.? 25 cts.? $33\frac{1}{4}$ cts.? $37\frac{1}{4}$ cts.? $62\frac{1}{4}$ cts.?
 7. What part of 12 is 4? What is the quotient of 4 divided by 12?

202. The quotient of two like numbers is often called their **ratio**.

The questions

What <i>part</i> of 12 is 4?	} are all answered by the fraction $\frac{1}{3}$.
What <i>fraction</i> of 12 is 4?	
What is the <i>quotient</i> of $4 \div 12$?	
What is the <i>ratio</i> of 4 to 12?	

ORAL EXERCISES

1. State the ratio of 16 oz. to 20 oz. Of 10 min. to 15 min.
State the ratio of the gain to the cost :

	2.	3.	4.	5.	6.
Cost.....	\$8	$\$1\frac{1}{4}$	\$.50	\$1.75	\$26.00
Gain.....	2	$\frac{1}{4}$	$.12\frac{1}{2}$	.25	5.20

203. Many problems involve finding the average of several numbers.

EXAMPLE: On three consecutive days a traveler spent \$7.85, \$6.15, and \$6. How much did he spend in all? Had he spent an equal amount each day, how much must it have been to make the same total expenditure? This is called his *average* daily expenditure for the 3 days.

204. The **average** of several numbers is the quotient of their sum divided by their number.

Thus, the average of the three numbers, 6, 8, and 13, is their sum divided by 3, or $\frac{6 + 8 + 13}{3} = 9$

WRITTEN EXERCISES

1. Write the ages to the nearest year of 4 pupils in your grade. Find the average age of these pupils.

2. The following table shows the attendance of a class. Find the average number of days that Mary attended per week. Find the average weekly attendance for each other pupil.

NAME.	1ST WEEK.	2D.	3D.	4TH.	5TH.	6TH.	7TH.
Mary	5 days.	4 da.	5 da.	5 da.	5 da.	3 da.	4 da.
Helen ...	5 "	5 "	4 "	3 "	5 "	5 "	4 "
Leslie	3 "	5 "	4 "	4 "	5 "	5 "	5 "
Charles .	5 "	5 "	5 "	5 "	5 "	5 "	5 "
James ..	5 "	4 "	5 "	3 "	5 "	4 "	5 "

3. Find the average daily attendance of the class for the first week. For each of the following weeks.

4. The following table shows a number of birds and the number of insects destroyed by them in a period of 5 days:

BLACK-BILLED CUCKOO.		YELLOW-BILLED CUCKOO.	
Number of birds.....	46	109	
<i>Destroyed</i>		<i>Destroyed</i>	
Caterpillars.....	906	1,865	
Beetles.....	44	92	
Grasshoppers.....	96	242	
Spiders.....	15	86	
Others.....	130	112	

According to the above table, what was the average number of insects destroyed per each of the black-billed cuckoos? Per each of the yellow-billed cuckoos?

5. There were 155 birds. What was the average number of insects destroyed per bird?

6. If it took 5 days to devour these insects, what was the average number destroyed per day?

7. A Swanson hawk destroys on the average 100 grasshoppers per day. How many grasshoppers do 300 of these birds destroy in a month of 30 days?

THE USE OF LETTERS

205. The use of letters is of value in solving certain kinds of problems.

PREPARATORY.

1. If there are 8 books on one shelf and 12 books on another, how many books are there on both shelves? If there are a books on one shelf and b books on another, how many books are there on both shelves?

This sum is written $a + b$.

2. Goods costing \$6 were sold by a merchant for \$8. How many dollars did he gain? If goods costing b dollars were sold at a profit for a dollars, how many dollars were gained?

The expression for the gain is $a - b$.

3. If a barrel of apples costs \$3, what will 3 bbl. cost? 4 bbl.? 12 bbl.? n bbl.?

The last result is written $3n$.

4. If there are 4 rows of apple-trees in an orchard and 8 trees in each row, how many trees are there in the orchard? How many trees are there in an orchard with b rows of 8 trees each? How many trees are there in an orchard with b rows of a trees each?

The product of a and b , or $a \times b$, is written ab .

5. How many tons of coal at \$5 a ton can be bought for \$25? How many tons at b dollars a ton can be bought for a dollars?

The operation a divided by b is written $a \div b$ or $\frac{a}{b}$.

206. EXAMPLES:

1. The metal types used in printing are made of 4 parts by weight of lead to 1 part of antimony. How much lead is there in 85 lb. of type? How much antimony?

Solution: (1) Let a stand for the number of pounds of antimony.

(2) The number of pounds of lead is $4a$.

(3) $a + 4a = 5a$. Why?

(4) Therefore, $5a = 85$, and $a = \frac{85}{5} = 17$.

(5) There are 17 lb. of antimony and 68 lb. of lead in 85 lb. of type.

2. A rectangular park is twice as long as it is wide and has a perimeter of 18 mi. Find its length and breadth in miles.

Solution: (1) Let x stand for the number of miles in the width of the park.

(2) The number of miles in the length is $2x$.

(3) The perimeter is $2x + 4x = 6x = 18$ mi.

(4) Therefore, the width = 3 mi., and the length 6 mi.

ORAL EXERCISES

1. What is the value of $a + b$ when $a = 6$ and $b = 14$? When $a = 8$ and $b = 20$? When $a = 16$ and $b = 14$?

2. What is the value of $a - b$ when $a = 25$ and $b = 10$? When $a = 15$ and $b = 7$? When $a = 30$ and $b = 14$?

3. What is the value of ab when $a = 3$ and $b = 4$? When $a = 50$ and $b = 14$?

4. What is the value of $\frac{a}{b}$ when $a = 30$ and $b = 6$? When $a = 42$ and $b = 7$? When $a = 56$ and $b = 7$?

WRITTEN EXERCISES

1. The perimeter of a rectangular farm is $1\frac{1}{2}$ mi. The length is $\frac{1}{4}$ of a mile more than the breadth. Find its dimensions.

2. A man left $\frac{3}{4}$ of his estate to his children and divided the remainder equally among 4 charitable institutions, each receiving \$6,000. What was the value of his estate?

3. A newsboy delivers 75 papers per day. He delivers twice as many in the morning as in the evening. How many does he deliver in the morning?

4. A man owned $\frac{3}{4}$ of a store; he sold $\frac{1}{2}$ of his share for \$3,000. Find the value of the store.

5. A contractor, wishing to dig a cistern, finds it most convenient to make it 5 ft. square. How deep must it be dug to contain 750 gal.? (Use 1 cu. ft. = $7\frac{1}{2}$ gal.)

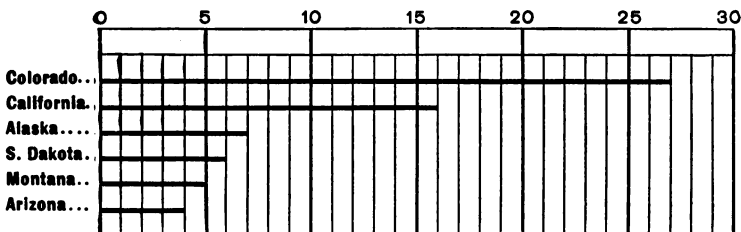
NUMBER PICTURES, OR GRAPHS

207. Numbers may be represented by pictures, called **graphs**, and the results of problems can be read from these pictures directly without computation.

The following list gives the value of the gold produced by the states mentioned in a recent year:

Colorado ..\$27,000,000	Alaska ....\$7,000,000	Montana ..\$5,000,000
California.. 16,000,000	S. Dakota. 6,000,000	Arizona... 4,000,000

These values are more easily compared if they are represented by parallel lines. Thus each *division* on the scale represents *1 million*.



WRITTEN EXERCISES

1. Draw on the blackboard the same set of lines for the exercise above, using 1 inch for each division of the scale.

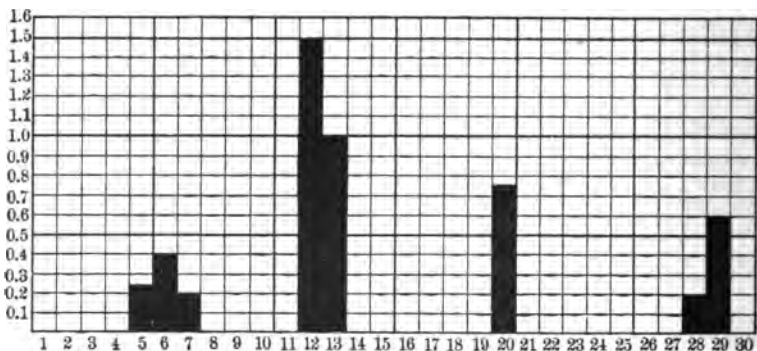
2. The following tables show the approximate production of certain articles of trade. Draw lines to represent the numbers in each table:

(1) SILVER. <i>Million dollars.</i>	(2) COPPER. <i>100,000 tons.</i>	(3) COTTON. <i>Million bales.</i>
Nevada..... 1.5	Utah..... 0.2	Arkansas $\frac{7}{8}$
California.... 4	California 0.3	Alabama..... 1
Utah..... 12	Arizona..... 0.5	Mississippi.... $1\frac{1}{2}$
Montana 18	Michigan..... 0.7	Georgia..... $1\frac{1}{2}$
Colorado 26	Montana..... 2.5	Texas..... 3

3. This table gives a daily record of rainfall in September. What was the rainfall for the month?

DAY.	5TH.	6TH.	7TH.	12TH.	13TH.	20TH.	28TH.
Inches....	.25	.4	.2	1.5	1	.75	.2

4. The adjacent lines in the figure are $\frac{1}{10}$ in. apart. How high is each of the dark columns? How do the heights of the columns compare with the records of rainfall in the table of Exercise 3?



Find, from the diagram above, the rainfall on the 29th of September.

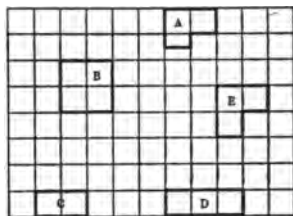
5. Robert measured the rainfall for April. The records were:

DAY.	5TH.	6TH.	10TH.	11TH.	12TH.	24TH.	30TH.
Inches....	.8	.3	.2	1	.5	.6	.2

Represent the rainfall graphically as in Oral Exercise 4.

6. What is the difference between the greatest and the least rainfall for the month?

7. Insurance agents use squared paper to show distances between buildings. If the side of each small square represents 10 ft., how far apart, according to the figure, are the buildings, E and B?



8. How far apart are C and D? C and B? E and D?

9. What is the greatest length and greatest breadth of building A? Of B? Of C? Of D? Of E?

10. The table shows the average annual rainfall of various places:

Chicago.....	34.8	Sacramento....	20.9	Pensacola.....	57.1
Boston.....	45.0	Denver.....	14.5	Mobile.....	62.2
St. Louis.....	41.1	New York City.	44.8	Yuma.....	3.0

Draw on the blackboard horizontal lines to represent the numbers in this table.

11. Represent graphically these readings of a thermometer (above zero):

SUN.	MON.	TUES.	WED.	THURS.	FRI.	SAT.
27½°	28°	30°	29°	31½°	29½°	31°

REVIEW

Plan the solution, but omit the computation :

1. The cyclometer of a bicycle read as follows at the close of each of these days: Monday, 841.62 mi., Tuesday, 873.84 mi., Wednesday, 910.05 mi., Thursday, 919.42 mi. Find the average daily ride.

2. On Monday morning a cistern contained 627.5 gal. of water; Tuesday it rained, and 127.46 gal. ran into the cistern; Thursday it rained, and 472.01 gal. ran into the cistern; the following Monday morning there were 710.91 gal. of water in the cistern. Find the average daily consumption of water.

3. In a recent year 2,895,661 dozen pairs of leather gloves and mittens were made in the United States. How many pairs was this per inhabitant, the population being 76,303,387?

4. The distance from Cincinnati to St. Louis is 341 mi. How long will it take a train to make the run, if it goes at the rate of 28.3 mi. per hour the first three hours, 26 mi. the next 2.7 hr., and 30.7 mi. the remainder of the time?

Solve :

5. By density of population is meant the average number of inhabitants per square mile. For Massachusetts the density is 348.9. The land area is 8,040 sq. mi. Find the population of Massachusetts.

6. The population of Mississippi is 1,551,270; its density of population is 33.5. Find its land area.

7. The population of Wisconsin is 2,069,042; its land area is 54,450 sq. mi. Find its density of population.

8. Two steamers left New York for Liverpool at 10 A.M., Saturday. The average speed of the first was 386.4 mi. per day; of the second, 495.35 mi. How far apart were they at 10 P.M. the following Wednesday?

9. If 8 hr. of labor are understood to constitute a day's work, and a workman receives \$1.50 a day on this basis, how much does he receive for 36 hours' work? How much does he receive per hour? For 3 hours' work?

10. On the basis of Exercise 9, how many dollars does a man earn in a week who works $8\frac{1}{2}$ hr. on Monday, 6 hr. on Tuesday, 8 hr. on Wednesday, 7 hr. on Thursday, 9 hr. on Friday, and 4 hr. on Saturday?

11. The following table shows the number of hours worked by A, B, C, D in one week at a factory; also their wages per day on the basis of an 8-hour day. On this basis how many days did each man work during the week?

	MON.	TUES.	WED.	THUR.	FRI.	SAT.	WAGES.	TOTAL.
A	8	$7\frac{1}{2}$	$7\frac{1}{2}$	6	9	8	\$1.25	
B	$7\frac{1}{2}$	$8\frac{1}{2}$	8	$8\frac{1}{2}$	6	8	1.50	
C	8	$6\frac{1}{2}$	0	8	0	6	2.00	
D	6	$5\frac{1}{2}$	$6\frac{1}{2}$	9	$8\frac{1}{2}$	8	1.75	

12. What is the average number of hours per day for each man in Exercise 11?

13. According to Exercise 11, what are the total wages of each for the week?

14. What is the average amount earned daily by each man for the 6 days?

15. What is the total pay-roll for the four men?

16. How many hours did C's week lack of being six 8-hour days?

17. A man earned \$840 a year and spent \$780. What part of his earnings did he spend? What is the ratio of his expenditures to his income?

18. A copper ore mined in Alaska contains 48 lb. of copper, 27 oz. of silver, and .035 oz. of gold per ton. How many pounds of each metal in 1000 tons of ore?

CHAPTER VI

DECIMAL FRACTIONS—PERCENTAGE

DECIMAL FRACTIONS

Notation and Numeration

208. The following table shows the names of the places, or orders, of decimals from tenths to millionths.

Tens	Units	Decimal Point	Tenths	Hundredths	Thousandths	Ten-thousandths	Hundred-thousandths	Millionths
3	7	.	4	0	6	3	6	9

The number in the table is read *thirty-seven and four hundred and six thousand, three hundred and sixty-nine millionths*.

209. A unit of any order is 10 times a unit of the next order at the right, and $\frac{1}{10}$ of a unit of the next order at the left.

ORAL EXERCISES

1. Counting from the decimal point, what decimal place is occupied by: Hundredths? Ten-thousandths? Millionths? Hundred-thousandths?

2. How many decimal places are needed to express: Ten-thousandths? Thousandths? Millionths? Hundred-Thousandths?

Read :

- | | | | |
|-----------|------------|-------------|--------------|
| 3. .303. | 6. .0078. | 9. .00015. | 12. .70536. |
| 4. .065. | 7. .00005. | 10. .01708. | 13. .136732. |
| 5. 1.863. | 8. .10001. | 11. .88888. | 14. .250875. |

WRITTEN EXERCISES

Express in figures :

1. Thirty and 5 thousandths.
2. Eighty-seven and 25 thousandths.
3. 100 and 263 ten-thousandths.
4. 408 and 1879 ten-thousandths.
5. 96 and 497 millionths.
6. Four hundred seventy-five hundred-thousandths.
7. Thirty-four thousand, three hundred forty-six hundred-thousandths.
8. Nine hundred twenty-four thousand, five hundred sixty-three millionths.

Reduction of a Decimal Fraction to a Common Fraction

210. EXAMPLE: Reduce .0825 to the form of a common fraction.

$$.0825 = \frac{825}{10000} = \frac{33}{400}.$$

211. Write the decimal fraction as a common fraction, and reduce it to its lowest terms.

WRITTEN EXERCISES

Reduce to common fractions in their lowest terms :

- | | | | |
|-----------|------------|-------------|--------------|
| 1. .625. | 5. .07525. | 9. .04565. | 13. .00475. |
| 2. .3125. | 6. .1275. | 10. .00375. | 14. .12575. |
| 3. .0565. | 7. .0625. | 11. .875. | 15. .400375. |
| 4. .0075. | 8. .15625. | 12. .0025. | 16. .01275. |

Reduction of a Common Fraction to a Decimal Fraction

212. To reduce a common fraction to a decimal, divide the numerator by the denominator, annexing as many zeros to the numerator as are necessary to obtain in the quotient the desired number of decimal places.

The plus sign is used to indicate that the quotient is not complete and that therefore the decimal is approximate.

EXAMPLE : Reduce $\frac{3}{11}$ to a decimal of 5 places.

$$\begin{array}{r} 11 \overline{) 3.00000} \\ \underline{.27272} + \end{array}$$

If the denominator is greater than 12 it is better to use long division. If the divisor has small factors, as $105 = 3 \times 5 \times 7$, it is better to divide successively by the factors as 3, 5, 7.

WRITTEN EXERCISES

Reduce to decimals containing not more than 5 places :

- | | | | |
|---------------------|----------------------|----------------------|----------------------|
| 1. $\frac{3}{16}$. | 5. $\frac{8}{9}$. | 9. $\frac{4}{7}$. | 13. $\frac{7}{8}$. |
| 2. $\frac{7}{15}$. | 6. $\frac{11}{12}$. | 10. $\frac{5}{13}$. | 14. $\frac{9}{20}$. |
| 3. $\frac{7}{16}$. | 7. $\frac{4}{11}$. | 11. $\frac{9}{13}$. | 15. $\frac{5}{14}$. |
| 4. $\frac{8}{33}$. | 8. $\frac{8}{15}$. | 12. $\frac{7}{9}$. | 16. $\frac{5}{18}$. |

Addition and Subtraction**WRITTEN EXERCISES**

Add as rapidly as possible :

From 1 to $1\frac{1}{2}$ minutes per problem is sufficient.

- | | | | |
|-------------|---------------|----------------|----------------|
| 1. 46.072 | 2. 12.4032 | 3. 9.6789 | 4. 15.3009 |
| 19.678 | 7.96 | 4.33 | 4.5 |
| 7.125 | 6.8704 | .0085 | 7.311 |
| 8.005 | .0009 | 6.2376 | .453 |
| 10.86 | 36.6333 | 3.1405 | 1.008 |
| 6.905 | 9.3008 | 9.999 | .721 |
| <u>.697</u> | <u>3.1225</u> | <u>12.3777</u> | <u>22.1145</u> |

5. 88.1263	6. .12245	7. .845631	8. .05213
44.9977	.67809	.234652	2.1072
30.4436	.00043	.198273	.452
6.7384	.13067	.203674	3.11127
3.0097	.40856	.098765	.5207
.0009	.20458	.123456	.0095
18.5555	.00777	.210987	.525
<u>9.2121</u>	<u>.33333</u>	<u>.446655</u>	<u>.0255</u>

Subtract as rapidly as possible :

9. 4.6633	12. 7.0638	15. 12.0066
<u>1.8459</u>	<u>6.0987</u>	<u>5.4399</u>
10. .86354	13. .56337	16. .178962
<u>.55634</u>	<u>.48732</u>	<u>.054673</u>
11. 306.	14. 517.3	17. 9.
<u>31.72</u>	<u>25.666</u>	<u>.4561</u>

Solve :

18. A business house found that its rent was .0125 of its gross business, that its salaries were .3375 of its gross business. What part of its gross business did rent and salaries equal?

19. A filing cabinet consists of three parts whose heights are respectively 1.25 ft., 1.75 ft., 1.5 ft. The cabinet stands on a base 1.75 ft. high. Find the total height of the piece.

20. The cabinet mentioned in Exercise 19 stands in a room 9 ft. 9 in. high. Express decimally the height of the ceiling above the top of the cabinet.

21. A farmer's state tax was \$.005 per dollar, his school tax \$.016, and his county tax \$.0065. What was his total tax per dollar?

22. The tax rate in a certain city is \$.028 per dollar, and in a village the rate is \$.0185. By how much does the city tax exceed the village tax?

Multiplication**213. PREPARATORY.**

1. Observe the relation between these two multiplications :

$$\begin{array}{r}
 4.5 \\
 \underline{23} \\
 135 \\
 \underline{90} \\
 103.5
 \end{array}
 \qquad
 \begin{array}{r}
 4.5 \\
 \underline{2.3} \\
 135 \\
 \underline{90} \\
 10.35
 \end{array}$$

The result of multiplying 4.5 by 23 is how many times as great as that of multiplying it by 2.3? Then what part of 103.5 must be taken to get the product of 4.5 and 2.3?

$$\frac{1}{10} \text{ of } 103.5 = (\quad)?$$

214. The numbers multiplied to form a product are called the **factors** of the product.

215. PREPARATORY.

1. Name the factors in each of the above multiplications.
2. How does the number of decimal places in the product compare with the total number in the factors in each case?
3. Observe the relation between these two multiplications:

$$\begin{array}{r}
 2.136 \\
 \underline{38} \\
 17088 \\
 \underline{6408} \\
 81.168
 \end{array}
 \qquad
 \begin{array}{r}
 2.136 \\
 \underline{.038} \\
 17088 \\
 \underline{6408} \\
 .081168
 \end{array}$$

The result of multiplying 2.136 by 38 is how many times as great as that of multiplying it by .038?

$$\frac{1}{1000} \text{ of } 81.168 = (\quad)?$$

216. *To multiply decimals, proceed as with integers, and set off from the right as many decimal places in the product as there are decimal places in the factors. If there are not figures enough in the product to fill all of the decimal places, supply zeros.*

WRITTEN EXERCISES

Multiply :

$$\begin{array}{r} 1. \quad 4.96 \\ \quad \underline{2.5} \end{array}$$

$$\begin{array}{r} 7. \quad 6.25 \\ \quad \underline{6.25} \end{array}$$

$$\begin{array}{r} 13. \quad 17.28 \\ \quad \underline{1.2} \end{array}$$

$$\begin{array}{r} 19. \quad 16.3 \\ \quad \underline{29.8} \end{array}$$

$$\begin{array}{r} 2. \quad 53.9 \\ \quad \underline{1.3} \end{array}$$

$$\begin{array}{r} 8. \quad 1111 \\ \quad \underline{3.33} \end{array}$$

$$\begin{array}{r} 14. \quad 9015 \\ \quad \underline{18.5} \end{array}$$

$$\begin{array}{r} 20. \quad 9.02 \\ \quad \underline{4.05} \end{array}$$

$$\begin{array}{r} 3. \quad 100.1 \\ \quad \underline{.25} \end{array}$$

$$\begin{array}{r} 9. \quad 13.25 \\ \quad \underline{4.2} \end{array}$$

$$\begin{array}{r} 15. \quad 50.05 \\ \quad \underline{202} \end{array}$$

$$\begin{array}{r} 21. \quad 77.7 \\ \quad \underline{9.9} \end{array}$$

$$\begin{array}{r} 4. \quad 5.87 \\ \quad \underline{86.5} \end{array}$$

$$\begin{array}{r} 10. \quad 1965 \\ \quad \underline{4.6} \end{array}$$

$$\begin{array}{r} 16. \quad 112.2 \\ \quad \underline{6.64} \end{array}$$

$$\begin{array}{r} 22. \quad 69.9 \\ \quad \underline{38} \end{array}$$

$$\begin{array}{r} 5. \quad 65.85 \\ \quad \underline{1.44} \end{array}$$

$$\begin{array}{r} 11. \quad 40.05 \\ \quad \underline{1.8} \end{array}$$

$$\begin{array}{r} 17. \quad 96.15 \\ \quad \underline{8} \end{array}$$

$$\begin{array}{r} 23. \quad 425 \\ \quad \underline{.88} \end{array}$$

$$\begin{array}{r} 6. \quad 46.75 \\ \quad \underline{1.25} \end{array}$$

$$\begin{array}{r} 12. \quad 1.24 \\ \quad \underline{6.25} \end{array}$$

$$\begin{array}{r} 18. \quad 200.7 \\ \quad \underline{.14} \end{array}$$

$$\begin{array}{r} 24. \quad 7.07 \\ \quad \underline{5.05} \end{array}$$

25. Find the area of a rectangle of sides 45.5 ft. and 5.5 ft.

26. Find the area of a square 3.25 yd. on a side.

27. What is the cost of 26.5 ft. of moulding at 8.5 cts. a foot?

28. What is the cost of 46.5 yd. of cloth at 6.5 cts. a yard?

29. What is the cost of 136.8 sq. yd. of cement walk at \$3.25 per square yard?

30. How many miles does an automobile travel in 7.8 hr., if it goes at the rate of 23.75 mi. per hour?

31. What is the cost of $5\frac{1}{2}$ yd. of cloth at \$.15 a yard?

32. For what does $26\frac{3}{4}$ lb. of butter sell, at \$.25 a pound?

33. The base of a tower had 8 sides each 17.75 ft. long. How many feet was it around the base of the tower?

34. A train travels at the rate of 38.95 mi. per hour. How far will it travel in $18\frac{1}{2}$ hr.?

Division

217. PREPARATORY.

1. Multiply both divisor and dividend by 10 in this expression: $3.6 \div .6$. Then $3.6 \div .6$ is the same as $36 \div 6$.

2. How can you show that $1.25 \div .25$ is the same as $125 \div 25$?

3. How can you show that $.625 \div .5$ is the same as $6.25 \div 5$?

218. In dividing by a decimal it is easier first to multiply both dividend and divisor by a power of 10 such as to make the divisor an integer. This is done by moving the decimal point in each the same number of places.

EXAMPLE: The area of a rectangle is 4.472 sq. ft., and its altitude is .26 ft. How may the length of the base be found?

Divide 4.472 by .26.

Solution:

$$\begin{array}{r}
 17.2 \\
 26 \overline{)447.2} \\
 \underline{26} \\
 187 \\
 \underline{182} \\
 5.2 \\
 \underline{5.2} \\
 0
 \end{array}$$

In the division at the right, 26 is taken instead of .26, and 447.2 instead of 4.472. Why does $447.2 \div 26 = 4.472 \div .26$?

How is the position of the decimal point in the quotient related to that of the decimal point in the dividend?

219. *To divide decimals, make the divisor a whole number by multiplying both divisor and dividend by the proper power of 10. Place the first figure of the quotient over the last figure of the part of the dividend first used; place the decimal point of the quotient over the decimal point of the dividend. If the number of decimal places in the divisor exceeds that in the dividend, zeros may be added to the dividend.*

220. The work of division is tested by comparing the dividend with the product of the quotient and the divisor plus the remainder.

WRITTEN EXERCISES

Divide and test :

- | | | |
|------------------------|-------------------------|-------------------------|
| 1. $3.75 \div 5$. | 6. $3.06 \div 6$. | 11. $3.06 \div .06$. |
| 2. $.625 \div .25$. | 7. $4.494 \div .70$. | 12. $81.54 \div 27$. |
| 3. $42.63 \div .213$. | 8. $423.4 \div 7.3$. | 13. $6.636 \div .79$. |
| 4. $69.76 \div .032$. | 9. $885.8 \div 1.11$. | 14. $97.336 \div .47$. |
| 5. $121.67 \div 2.3$. | 10. $80.48 \div 1.64$. | 15. $160.05 \div .05$. |

Divide to not more than 3 decimal places :

16. 5.5×11.25 by 6.75 .
17. 20.9×35.75 by 14.8×7.35 .
18. 15.5×18.3 by 40.5 .
19. 36.75×13.6 by 17.8×40.35 .
20. 19.05×7.63 by $3.125 \times .17$.
21. 40.15×3.09 by 6.005×3.6 .
22. $18\frac{1}{2} \times 6.25$ by $11.86 \times 5\frac{1}{2}$.

Solve :

23. At 2.4 cts. per mile, the fare from New York to Chicago would be \$21.60. Find the distance.

24. At an average speed of 25.6 mi. per hour, how long would it take a train to go from Chicago to Denver (1,028 mi.)?

25. A rod contains 16.5 ft. How many rods are there in a mile (5,280 ft.)? In 2,541 ft.?

26. The pendulum of a clock made 120 swings in a minute. How many seconds did it take the pendulum to make 1 swing?

27. A cubic inch of mercury weighs about .5 lb. How many inches high must a tube be whose base is 1 sq. in. in order to hold 100 lb. of mercury?

28. There are 30.25 sq. yd. in a square rod. How many square rods are there in 226.875 sq. yd.?

29. A train traveled 1080.3 mi. in 19.5 hr. How many miles was this per hour?

PERCENTAGE

Meaning of Rate Per Cent

221. PREPARATORY.

1. Of 5 hundred strawberry plants, 3 per hundred died. How many died?

2. Of 600 pupils in a school 2 per hundred were absent. How many were absent?

3. A contractor bought 12,000 bricks; 14 per hundred were defective. How many defective bricks were there in the lot?

In expressions like the above, **per cent** is commonly used instead of *per hundred*.

Per cent is derived from the Latin *per centum* meaning *per hundred*.

Thus, 6 per cent (6%) means 6 per hundred. The symbol % is read *per cent*.

222. The phrase **per cent** is used when a *rate per hundred* is meant. The term **percentage** is used to express the actual number resulting from the application of the rate.

Thus, in the expression "10 per hundred of the total population of 10,000 were Americans", *10 per hundred* is the *rate* and may be read *10 per cent*. The *actual number* of Americans, or *1000* out of *10,000*, is the *percentage* of Americans.

ORAL EXERCISES

1-6. The rate per cent of salt in the bodies of water named is approximately:

Caspian Sea.....	1	Atlantic Ocean.....	4
Black Sea.....	1	Mediterranean Sea.....	4
Great Salt Lake.....	20	Dead Sea.....	6½

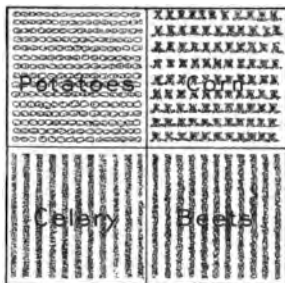
In each case, how many pounds of salt are there in every 100 pounds of water?

7. A vegetable garden contained four kinds of plants as shown in the picture. What part of the whole garden was used for potatoes?

8. What part was occupied by potatoes and corn together?

9. How many hundredths of the garden were used for potatoes? For corn? For both of these?

10. One-fourth of the garden is how many hundredths of it? How many per cent of it?



$\frac{1}{4}$ of the garden = .25 of it = 25% of it.

11. One-half of the garden is how many hundredths of it? How many per cent of it?

$\frac{1}{2}$ of the garden = .50 (or .5) of it = 50% of it.

12. $\frac{3}{4}$ of the garden = () hundredths of it = () % of it?

13. The whole garden = () hundredths of it = () % of it?

14. $\frac{1}{10}$ of a farm = () hundredths of it = () % of it?

15. $\frac{1}{5}$ of a farm = () hundredths of it = () % of it?

16. $\frac{2}{5}$ of a dollar = () hundredths of it = () % of it?

17. $\frac{3}{5}$ of a dollar = () hundredths of it = () % of it?

18. $\frac{4}{5}$ of a dollar = () hundredths of it = () % of it?

WRITTEN EXERCISES

1. Draw a square and divide it into 10 equal rectangles. Divide each rectangle into 10 equal squares. How many small squares are there in the figure?

2. Shade 1% of the squares in the figure mentioned in Exercise 1. Shade 5% of them; 10%; 25%; 50%; 75%; 80%.

3. Draw a circle and shade 25% of it; 50% of it; 75%.

4. Draw a rectangle whose breadth is 20% of its length. One whose breadth is 75% of its length.

5. On paper ruled in squares draw a square 10 in. on a side. Shade 1% of its area. Shade a square whose area is 25% of that of the given square.

6. Draw on the board a square 10 in. on a side. What is its area? How many square inches are there in 25% of it? In 75% of it? In 40%? In 53%?

7. Draw a rectangle 10 in. long whose area shall equal 10% of that of the square of Exercise 6. Draw other rectangles each 10 in. long to equal 20%; 30%; 50%; 70% of the given square.

8. Draw a rectangle 1 in. wide whose area is 5% of that of the square of Exercise 6. Draw others of the same width with areas 7%; 3%; 15%; 29% of the area of the square. How long would such a rectangle be in order to equal 100% of the square?

Finding a Percentage

223. PREPARATORY.

1. .45 of a number is how many per cent of it?
2. 25% of a number is how many hundredths of it? How many fourths of it?
3. Taking $\frac{1}{4}$ of a number is taking how many per cent of it?
4. Taking $\frac{3}{4}$ of a number is taking how many per cent of it?
5. Taking $\frac{1}{3}$ of a number is taking how many per cent of it?

224. EXAMPLES:

1. Find 47% of 216.

Solution: (1) 47% of 216 = $.47 \times 216$.

(2) $.47 \times 216 = 101.52$.

2. Find $33\frac{1}{3}\%$ of 216.

Solution: (1) $33\frac{1}{3}\%$ of 216 = $\frac{1}{3}$ of 216.

(2) $\frac{1}{3}$ of 216 = 72.

225. To find the percentage of a number at any rate per cent, multiply it by the corresponding number of hundredths or the corresponding common fraction.

TABLE OF CORRESPONDING NUMBERS

PER CENT.	DECIMAL.	FRACTION.	PER CENT.	DECIMAL.	FRACTION.
5%	.05	$\frac{1}{20}$	50%	.50 or .5	$\frac{1}{2}$
10%	.10 or .1	$\frac{1}{10}$	62.5%	.625	$\frac{5}{8}$
12.5%	.125	$\frac{1}{8}$	66 $\frac{2}{3}$ %	.66 $\frac{2}{3}$	$\frac{2}{3}$
16 $\frac{2}{3}$ %	.16 $\frac{2}{3}$	$\frac{1}{6}$	75%	.75	$\frac{3}{4}$
20%	.20 or .2	$\frac{1}{5}$	83 $\frac{1}{3}$ %	.83 $\frac{1}{3}$	$\frac{5}{6}$
25%	.25	$\frac{1}{4}$	87.5%	.875	$\frac{7}{8}$
33 $\frac{1}{3}$ %	.33 $\frac{1}{3}$	$\frac{1}{3}$	90%	.90 or .9	$\frac{9}{10}$

226. The number to which the rate is applied is called the base.

227. The relation of the three numbers—Base, Rate, and Percentage—may be expressed as follows:

Base multiplied by Rate equals Percentage.

WRITTEN EXERCISES

Find :

- | | | |
|---------------------------------|--------------------|-------------------|
| 1. 20% of 200? | 6. 10% of 1,000? | 11. 75% of 1,600? |
| 2. 25% of 500? | 7. 50% of 2,000? | 12. 60% of 1,200? |
| 3. 33 $\frac{1}{3}$ % of 2,760? | 8. 87.5% of 900? | 13. 74% of 286? |
| 4. 66 $\frac{2}{3}$ % of 3,615? | 9. 37.5% of 1,200? | 14. 16% of 1,400? |
| 5. 43% of 186? | 10. 48% of 160? | 15. 9% of 963? |

Solve :

16. In a certain territory 576,660 bu. of corn were grown in 1 yr., of which 66 $\frac{2}{3}$ % was exported. How many bushels was this?

17. In a recent year the imports of Mexico from the United States were 44% of the exports to the United States. How many dollars' worth of imports did Mexico receive per \$100-worth of exports to the United States? For every \$500? For every \$50? For every \$25?

18. If 75% of a certain ore is copper, how many pounds of copper are there in 100 lb. of ore? In 4,480 lb. of ore?

19. If on an average 75% of the eggs placed in an incubator hatch, and 90% of the chickens transferred to the brooder live to become marketable fowls, how many fowls are grown from 80 doz. eggs?

20. Diminish 100 by 10% of itself; the result by 33 $\frac{1}{3}$ % of itself; this result by 33 $\frac{1}{3}$ % of itself. What is the final result? How many per cent of 100 is it?

21. A merchant began with \$5,000 capital, and at the end of each year added his profit to his capital. His profit each year is shown by the following percentages of the capital invested: first year, 20%; second year, 25%; third year, 10%. What was his capital for the fourth year?

22. A man bought 320 acres of land and sold 90% of it to one neighbor, 33 $\frac{1}{3}$ % of the remainder to another, and 12.5% of the remainder to another. How many acres had he left?

23. A boat carried 3,125 tons of iron ore. This ore yielded 43.8% of iron. How many tons of iron in the cargo?

Finding How Many Per Cent One Number is of Another

228. PREPARATORY.

1. 5 is what part of 20? $\frac{1}{4}$, or $\frac{1}{4}$, is how many hundredths? 5 is how many per cent of 20?

2. 4 is what part of 20? $\frac{1}{5}$, or $\frac{1}{5}$, is how many hundredths? 4 is how many per cent of 20?

3. Divide 735 by 3,500 and express the result in hundredths. 735 is how many hundredths of 3,500? How many per cent?

229. EXAMPLES:

1. 34 is how many per cent of 170?

Solution: (1) $34 \div 170 = .2 = .20$.

(2) Therefore, 34 is 20% of 170.

2. $266\frac{2}{3}$ is how many per cent of 400?

Solution: (1) $266\frac{2}{3} \div 400 = \frac{800}{3} \div 400 = \frac{2}{3} = .66\frac{2}{3}$.

(2) Therefore, $266\frac{2}{3}$ is $66\frac{2}{3}\%$ of 400.

230. *To find how many per cent one number is of another, divide the first number by the second. The number of hundredths in the quotient is the rate per cent.*

231. If we employ the terms Base, Rate, and Percentage, the above process may be stated:

Percentage divided by Base equals Rate.

The phrase "What per cent" is often used as an abbreviation for "How many per cent" or for "What rate per cent."

WRITTEN EXERCISES

1. 48 is how many per cent of:

96? 144? 200? 500? 480? 1000?

2. 28 is how many per cent of:

84? 140? 168? 200? 500? 700? 1,400?

3. 35 is how many per cent of:

70? 105? 210? 700? 770? 250? 1000?

4. 125 is how many per cent of:

125? 250? 1000? 500? 650? 900? 1,250?

5. 80 is how many per cent of:

240? 100? 80? 40? 20? 10? 8? 5?

6. A bank has a capital of \$100,000 and keeps \$25,000 on hand. How many per cent is this reserve of the whole capital?

7. A trust company had a capital of \$3,000,000, and kept in reserve \$450,000. How many per cent was this reserve of the whole capital?

8. A man purchased a block of land for \$250,000 and paid at once \$50,000. How many per cent of the whole amount was this cash payment?

9. A house and lot cost \$6,500; the lot alone cost \$1,500. How many per cent was this of the whole cost?

10. To test flower-seeds, 200 seeds were planted; 40 plants sprouted. How many per cent of the seeds sprouted?

11. Fifty pounds of corn contain 35 lb. of starch. How many per cent of corn is starch?

Finding a Number from a Given Percentage

232. PREPARATORY.

1. If 7 is $\frac{1}{4}$ of a number, what is the number?

2. If 8 is $33\frac{1}{3}\%$ of a number, that is, $\frac{1}{3}$ of it, what is the number?

3. If 12 is 6% of some number, what is 1% of it? What is 100% of it?

233. EXAMPLES:

1. 20 is 4% of what number?

Solution: (1) $20 \div 4 = 5$, or 1% of the number.

(2) $100 \times 5 = 500$, or the whole of the required number.

Steps 1 and 2 are the same as $20 \div .04 = 500$.

2. 16 is 6% of what number?

Solution: $16 \div .06 = 266\frac{2}{3}$, the required number.

3. If 45 is $62\frac{1}{2}\%$ of a number, or $\frac{5}{8}$ of it, what is the number?

Solution: (1) $\frac{1}{5}$ of the number is $45 \div 5$, or 9.

(2) $\frac{5}{8}$ of the number is 8×9 , or 72.

(3) Steps (1) and (2) are the same as $45 \div \frac{5}{8} = 72$.

234. To find a number of which the percentage at a certain rate is given, divide the percentage by the number of hundredths corresponding to the rate per cent. Or, divide the percentage by the common fraction corresponding to the rate.

235. The above process may be stated in terms of Base, Rate, and Percentage as follows:

Percentage divided by Rate equals Base.

WRITTEN EXERCISES

1. 24 is 8% of what number?
4. 25% of $N = 7$. Find N .
2. 25 is 5% of what number?
5. 20% of $B = 12$. Find B .
3. 10% of () = 15?
6. 8% of $N = 24$. Find N .

7. A bag of grass seed contained 86 lb. of good seed, which was 61 $\frac{1}{4}$ % of its weight. What was the weight of all the grass seed?

8. A standard bushel of clover seed contains 48 lb. of good seed; this is 80% of the weight of a standard bushel. Find that weight.

9. A bushel of clover seed costing \$5.50 was found to contain 75% of good seed. At this rate what was the cost of a bushel of good seed?

10. A piece of woolen cloth lost 18% of its length in shrinking. The present length is 41 yd. If the cloth cost \$60 before shrinking, what was the price per yard?

11. When wheat is ground, 77 $\frac{1}{2}$ % by weight of the product is fine flour. How many bushels of wheat (60 lb.) are required to produce 1000 bbl. of fine flour (196 lb.)?

12. In drying green sycamore leaves 45% of their weight is lost by the evaporation of the water they contain. A quantity of leaves after drying weighed 4 $\frac{1}{2}$ oz. What did they weigh before drying?

REVIEW

ORAL EXERCISES

1. Counting from the decimal point, what place is occupied by hundredths? By thousandths? By millionths?

2. How many decimal places are needed to express any number of:

Hundredths? Thousandths? Millionths?

Ten-thousandths? Tenths? Hundred-thousandths?

Read:

3. .033. 5. .8763. 7. .63399. 9. .333333.

4. .005. 6. 5.00789. 8. .600853. 10. .900009.

11. 25% of a number is what fractional part of it? Answer the same question for 50% of it; 75%; 10%; 60%; 40%; 80%; $33\frac{1}{3}\%$; $66\frac{2}{3}\%$; 35%; 85%; 15%; $12\frac{1}{2}\%$; $37\frac{1}{2}\%$; $62\frac{1}{2}\%$; $87\frac{1}{2}\%$; $16\frac{2}{3}\%$; $83\frac{1}{3}\%$; 84%; 6%; 5%; 4%.

12. $\frac{1}{2}$ of a number is how many per cent of it? Answer the same question for $\frac{1}{4}$ of it; $\frac{1}{4}$; $\frac{1}{8}$; $\frac{1}{8}$; $\frac{1}{16}$; $\frac{1}{16}$; $\frac{1}{16}$; $\frac{1}{16}$; $\frac{1}{16}$; $\frac{1}{16}$; $\frac{1}{16}$; $\frac{1}{16}$; $\frac{1}{16}$; $\frac{1}{16}$; $\frac{1}{16}$; $\frac{1}{16}$.

13. Which of the following percentages would be found more easily, if the rates were expressed as common fractions: 25% of 1000? 40% of 1000? $46\frac{1}{2}\%$ of 1000? $12\frac{1}{2}\%$ of 888? 81% of 400?

14. A tract of land contained 640 acres, of which 80 acres were wooded. How many per cent of the tract was wooded? How many per cent was cleared?

WRITTEN EXERCISES

Add:

1. .1275 2. 16.875 3. 2.8645 4. .00084

.1363 19.008 7.0089 .00176

.9908 67.479 .6374 .08932

.4532 99.001 10.9009 .46754

Subtract :

5. 46.93	6. 30.0008	7. .900005	8. 400.005
<u>19.884</u>	<u>16.9909</u>	<u>.063548</u>	<u>33.399</u>

Reduce to common fractions :

9. .875.	11. .0075.	13. .9995.	15. .8888.
10. .6275.	12. .000125.	14. .6335.	16. .00085.

Reduce to decimal fractions of not more than 4 places :

17. $\frac{5}{8}$.	19. $\frac{5}{8}$.	21. $\frac{3}{16}$.	23. $\frac{11}{16}$.
18. $\frac{1}{16}$.	20. $\frac{11}{16}$.	22. $\frac{8}{11}$.	24. $\frac{3}{14}$.

Multiply :

25. 17.19×14.6 .	27. 99.25×8451 .	29. $.087 \times 1.009$.
26. 30.96×21.8 .	28. 106.3×2.009 .	30. $.045 \times .099$.

Divide to not more than 4 decimal places :

31. $6.25 \div 3.369$.	33. $4.006 \div 3.008$.	35. $185.6 \div 206.001$.
32. $84.51 \div 7.635$.	34. $72.36 \div .0025$.	36. $.01263 \div .00018$.

Solve :

37. A collector reported the following collections for one week. How much did he collect in all?

Mon. \$286.17	Tues. \$905.36	Wed. \$1000.33
Thurs. \$363.25	Fri. \$200.75	Sat. \$2059.48

38. The three sides of a triangular field measure 102.75 rd., 89.45 rd., 70.9 rd. What is the distance around the field?

39. From 5.068 oz. of platinum, 2.909 oz. were used. How many ounces were left?

40. A man earns \$1.87 $\frac{1}{2}$ a day. How much is this for a week?

41. When the price of calico is 7 $\frac{1}{2}$ cts. per yard, what is the cost of 81 yd.? Express the result in decimal form.

42. How much does a man earn in 11.75 da. at \$2.25 a day?

43. A tank holds 4.35 gal. How many times can it be filled from 34.8 gal. of oil?

44. Fill the blanks in the table:

STATE.	POPULATION.	PERSONS OF SCHOOL AGE: 5-20 YEARS.	PER CENT OF TOTAL.
Illinois.....	4,800,000	1,600,000	()
Indiana.....	()	800,000	32
Kansas.....	1,500,000	()	33½
Tennessee.....	2,000,000	()	40
Texas.....	()	1,200,000	40

45. Various commercial fertilizers are sold. They are intended to supply nitrogen, phosphoric acid, and potash to the soil. If nitrogen is valued at 16 cts. a pound, phosphoric acid at 4½ cts. a pound, and potash at 5 cts. a pound, what is the value of these substances in 100 lb. of a fertilizer of which 2½% is nitrogen, 10% available phosphoric acid, and 1½% potash?

46. Beef loses about 15% of its weight by boiling and 20% by roasting. How much will a piece of beef, weighing 10 lb. when raw, weigh after having been roasted? Boiled?

47. The water surface of Kentucky is 1% of the land surface; the total area is 40,000 sq. mi. Find the area of the land surface of Kentucky. Of the water surface.

48. The land surface of New Hampshire is about 9,000 sq. mi.; the water surface is 3½% of the land surface. Find the total area.

49. 10 lb. of apples were placed in an oven to dry. After drying they weighed 1 lb. 12 oz. How many pounds of water had evaporated from the apples? How many per cent of the weight had been lost in drying?

50. Potatoes contain 78% of water. How many pounds of water are there in a bushel of potatoes? (1 bu. of potatoes weighs 60 lb.)

51. Flour contains 12½% of water. How much water is there in a barrel of flour? (1 bbl. of flour weighs 196 lb.)

52. Walter took a 3-lb. sample of soil from a forest and dried it; afterward it weighed 2 lb. 4 oz. What part of the soil was water? How many per cent? 1 cu. ft. of the soil weighed 72 lb. How many pounds of water did it contain?

53. Horace sifted soil with a coarse sieve, thus retaining gravel in the sieve; he sifted the residue through a finer sieve, retaining sand in the sieve. He weighed soil, gravel, and sand in 6 experiments and found the weights as follows:

SAMPLE.	1st.	2d.	3d.	4th.	5th.	6th.
Soil taken.	24 oz.	36 oz.	72 oz.	84 oz.	90 oz.	120 oz.
Gravel	6 "	10 "	27 "	20 "	15 "	36 "
Sand.....	10 "	16 "	32 "	36 "	25 "	53 "

How many per cent of each lot of soil was gravel? Sand? Gravel and sand together?

54. Henry sifted 2 lb. of soil through a coarse sieve. The gravel remaining in the sieve weighed 5.4 oz. How many per cent of the soil was gravel?

55. John weighed out 10 oz. of green oak leaves; he dried them thoroughly and weighed them again; this time they weighed 5.1 oz. The loss of weight is due to the evaporation of water from the leaves while drying. How many per cent of the green leaves was water?

56. A cement walk consists, by weight, of 15% of gravel, 33 $\frac{1}{3}$ % of cement, and 51 $\frac{1}{3}$ % of sand. How many tons of each kind of material in a cement walk 100 ft. long, 4 $\frac{1}{2}$ ft. wide, and 6 in. deep, if each cubic foot weighs 75 lb.?

57. Fresh beef furnishes on the average 15.5% of protein, the chief tissue-building element of all foods. How many ounces of protein are there in 300 oz. of fresh beef?

58. Green corn furnishes on the average 3.1% by weight of protein. How many ounces of protein are there in 200 oz. of green corn?

59. 13.1% of eggs are protein. How many ounces of protein are there in 200 oz. of eggs?

60. The following table shows the average relative amounts of waste, water, protein, fat, and heat units derived from various staple foods:

ANIMAL FOOD.	WASTE PER CENT.	WATER PER CENT.	PROTEIN PER CENT.	FAT PER CENT.	HEAT UNITS PER POUND.
Beef.....	16.9	52.6	15.5	15.0	910
Veal.....	21.6	52.0	15.4	11.0	745
Mutton.....	10.3	39.0	13.8	36.9	1,770
Pork, fresh..	12.6	48.0	13.5	25.9	1,320
Chickens....	42.1	43.7	12.8	1.4	305
Fish (cod)...	30.2	58.5	11.1	0.2	220
Eggs.....	12.1	65.5	13.1	9.3	635
VEGETABLE FOOD.	CARBO- HYDRATES PER CENT.	WATER PER CENT.	PROTEIN PER CENT.	FAT PER CENT.	HEAT UNITS PER POUND.
Flour.....	75.6	12.0	11.4	1.0	1,635
Beans, dried	63.1	12.6	22.5	1.8	1,520
White bread	54.2	35.3	9.2	1.3	1,200
Corn, green .	20.4	75.4	3.1	1.1	440
Rice.....	79.4	12.3	8.0	0.3	1,620

According to the table above, how many units of heat are supplied by the fuel in 1 lb. of fresh beef? How many units are there in 5 lb.?

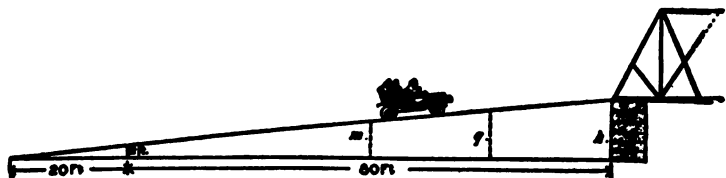
61. Similarly, how much water in 1 lb. of beef? In 36 lb.?

62. How many pounds of protein in 25 lb. of mutton? Of veal? Of rice? Of eggs? Of flour?

63. How many pounds of fat in 32 lb. of pork? Of fish? Of eggs? Of rice? Of beans? Of flour?

64. How much waste in 10 lb. of beef? In 10 lb. of mutton? Of eggs? Of flour? Of rice? Of corn?

65. The approach to this bridge rises 2 ft. for every 20 ft. horizontally. What is the height h ?



m and q in the picture are 20 ft. apart; also q and h .

66. What is the height m ? What is the height q ?

67. If the height h were 5 ft. only, and if the approach were 100 ft. long horizontally, what would be the rise of the approach for each 10 ft.?

The rise in the road is called its grade, and it is often indicated by stating the rise for some horizontal distance; e. g., the *grade* of the bridge approach is 2 ft. in 20 ft.

The grade per cent means the number of feet the grade rises vertically per 100 ft., on the level. Thus, the grade per cent shown in the picture is 10%. The grades of roads are seldom more than 3% or 4%.

68. What is the grade in Exercise 67?

69. What is the grade per cent in Exercise 67?

70. What is meant by a 12% grade? By a 5% grade? By a .5% grade? By a $\frac{1}{2}$ % grade?

71. How many feet does a 1% grade rise in a mile? A 10% grade? A 12% grade?

72. A horse that can draw 1000 lb. on a level can draw:

900 lb. on a	1% grade,	810 lb. on a	2% grade
750 " "	2.3% "	720 " "	2.5% "
640 " "	3 $\frac{1}{2}$ % "	600 " "	4% "

Find the number of feet rise per hundred of horizontal length in each case.

73. According to Exercise 72, on what grade can a horse draw 75% as much as on a level?

CHAPTER VII

BUSINESS APPLICATIONS

GAIN AND LOSS

236. The gain or loss is always reckoned on the cost.

EXAMPLES:

1. A merchant sold goods costing \$540 at a gain of 15%.
What was the gain? What was the amount received?

Solution: (1) .15 of \$540 = \$81, the gain.

(2) \$540 + \$81 = \$621, the amount received.

2. A real-estate agent bought a house for \$2,500 and sold it for \$3,000. How many per cent did he gain?

Solution: (1) \$3,000 - \$2,500 = \$500.

(2) \$500 ÷ \$2,500 = $\frac{1}{5}$.

(3) \$500 is $\frac{1}{5}$, or 20%, of \$2,500.

(4) The agent gained 20%.

3. A suit of clothes was sold for \$22 at a gain of 10%.
Find the cost.

Solution: (1) $c + .10c$, or $1.10c = \$22$.

(2) Therefore, $c = \frac{\$22}{1.10} = \20 .

Here the rate per cent of gain is expressed by a decimal.

4. A house, sold at a gain of 20%, brought \$2,100. Find its cost.

Solution: (1) Let c = cost. Then $\frac{1}{5}c$ = gain.

(2) $c + \frac{1}{5}c = \frac{6}{5}c$. $\frac{6}{5}c = \$2,100$.

(3) $c = \frac{5}{6}$ of \$2,100 = \$1,750.

Here the per cent of gain is expressed as a fraction.

WRITTEN EXERCISES

1. A man bought wheat in October at \$.80 and sold it in December at \$.85. How many per cent did he gain?

2. Mr. Williams sold a house for \$200 more than it cost; the gain was 5% of the cost. Find the cost.

3. A bicycle, sold at a loss of 10%, brought \$45. What was the cost?

4. In 1900 the population of New York City was 3,400,000; in 1890 it was 2,500,000. What was the gain per cent in 10 years?

Find the rate per cent of gain or loss in each case :

	5.	6.	7.	8.	9.
Cost.....	\$16.	\$25.	\$40.	\$1.20.	\$2.00.
Selling Price.....	\$20.	\$15.	\$48.	\$1.60.	\$1.80.

Find the cost :

	10.	11.	12.	13.
Gain or Loss.....	25%, gain.	20%, loss.	30%, gain.	20%, loss.
Selling Price.....	\$2.	\$6.	\$130.	\$1,500.

14. A tailor made $6\frac{1}{2}$ dozen coats with cloth at \$1.95 per yard; 3 yd. were required for each coat, and the making cost \$19.80 per dozen; he sold the coats at \$8.25 each. What was his rate per cent of gain?

15. A dealer bought a carload of coal, 38,000 lb; he sold it at \$7.50 per ton, and thus gained \$28.50 on the carload. Find the rate per cent of gain.

16. In 1900, there were in the United States about 200 million apple-trees, a gain of $66\frac{2}{3}\%$ since 1890. Find the number in 1890.

17. In a recent year there were produced in the United States about $9\frac{1}{2}$ million bales of cotton (a bale contains about 500 lb.); this was a gain of $26\frac{2}{3}\%$ over the crop of 10 years previous. Find the production in that year.

18. A dealer sold two typewriters, costing the same fixed price, for \$165; on one he gained twice as much as on the other; his total gain was \$45. What was the rate of gain on each?

19. A dealer sold two wagons of equal cost so as to gain five times as many dollars on one as he lost on the other; his total gain was \$200. What was the gain, or loss, on each?

20. A dealer sold a piano at a gain of 30%; the purchaser, after having used it a year, sold it for \$195 at a loss of 40% of its cost to him. Find the cost to the dealer.

COMMISSION

237. The percentage received by an agent for handling goods is called his **commission**.

EXAMPLES:

1. A commercial traveler, who receives a commission of 5% on his sales, earned \$28 in ten days. Find the amount of the sales.

Plan: (1) Let s = the amount of his sales.

$$(2) .05 \times s = \$28.$$

$$(3) \text{ Therefore } s = \$(\quad).$$

2. A man sold his house and lot through an agent, who charged a commission of 2% and remitted \$9,310. What was the selling price?

Plan: (1) Let s = selling price.

$$(2) s - .02 \times s = .98s = \$9,310.$$

$$(3) \text{ Therefore } s = \frac{\$9310}{.98} = \$(\quad).$$

3. Mr. Baker paid \$1,100 for sheep to stock his ranch. This includes the broker's commission of 10%. What did the broker pay?

Plan: (1) Let c = the cost.

$$(2) c + 10\% \text{ of } c = \$1,100.$$

$$(3) 1.10 c = \$(\quad).$$

$$(4) \text{ Therefore } c = \$(\quad).$$

WRITTEN EXERCISES

1. A real-estate agent sold a 200-acre farm at \$75 an acre. What was his commission at $2\frac{1}{2}\%$?

2. A commercial traveler receives 7% commission on the orders he takes; in 6 months he sells goods to the amount of \$9,800. How much does he earn in commissions?

3. An auctioneer received \$15 for selling \$500 worth of goods. What was his rate of commission?

4. A broker sold a farm for \$28,500, his commission being 2%. What was the amount of his commission?

5. A real-estate agent sold a house and lot for \$3,200; his commission was $2\frac{1}{2}\%$. How much did the owner receive?

6. An agent remitted \$142.50 to the owner of goods that he sold, and retained \$7.50 commission. For how much did he sell the goods? What was his rate of commission?

7. An agent sold 6 cottages at \$1000 each for $2\frac{1}{2}\%$ commission. What was his commission per cottage?

8. A real-estate agent collects rents amounting to \$400 and remits \$384 to the owner. What is his rate of commission?

9. A merchant gave bills to the amount of \$300 to an agency for collection; the agency charged 2% for collecting $\frac{1}{4}$ of the amount, but 5% for collecting the other half, on account of the trouble in collecting. How many dollars did the merchant receive?

10. A merchant gave bills aggregating \$300 to a collector who succeeded in collecting \$240, but reported the rest uncollectable. If the collector charged 8% of the amount collected, how much of the \$300 did the merchant lose? What was the percentage of loss?

11. Mr. Jones is an agent for an automobile company that pays him a commission of 10% on his sales. In one month he sold one automobile at \$760, and another at \$925. How much did he earn?

TRADE DISCOUNT

238. When for any reason a reduction is made from a fixed price, such a reduction is called a **discount**.

EXAMPLE: At the close of a season damaged goods were offered as follows:

(1)		(2)	
MARKED PRICE	DISCOUNT	MARKED PRICE	DISCOUNT
\$1.15	20%	\$39	33 $\frac{1}{3}$ %

Find the reduced price in each case.

Solution:

- (1) $100\% - 20\% = 80\%$. Then, 80% of $\$1.15 = .8 \times \$1.15 = \$.92$.
 (2) $100\% - 33\frac{1}{3}\% = 66\frac{2}{3}\%$. " $66\frac{2}{3}\%$ of $\$39 = \frac{2}{3}$ of $\$39 = \26 .

239. Many articles of merchandise have fixed prices, which are published in catalogues and price-lists. This price is known as the **list price**.

240. The price after the discount has been taken off is called the **net price**.

WRITTEN EXERCISES

1. Find the reduced price resulting from these discounts:

(1)		(2)	
MARKED PRICE	DISCOUNT	MARKED PRICE	DISCOUNT
\$15	10%	\$42	16 $\frac{2}{3}$ %

Determine the numbers to fill the blanks :

	LIST PRICE.	DISCOUNT.	NET PRICE.
2.	\$4.00	6%	()
3.	\$1.75	20%	()
4.	\$12.00	()	\$11.40
5.	\$225.00	()	\$202.50
6.	()	10%	\$8.10

	LIST PRICE.	DISCOUNT.	NET PRICE.
7.	()	15 %	\$17.00
8.	\$8.40	8½%	()
9.	\$4.80	12½%	()
10.	\$855.00	4½%	()
11.	()	2 %	\$10.29
12.	\$1,025.00	()	\$1,000.00
13.	()	12½%	\$87.50
14.	\$56.20	5 %	()

	LIST PRICE.	DISCOUNT.	NET PRICE.
15. Shakespeare (Temple Edn.)	\$26.00	20%	()
16. Roosevelt's Rough Riders..	\$2.00	15%	()
17. Hawthorne's Works, 8vo...	\$10.00	25%	()
18. Poe's Works, 6 vol., cloth..	\$7.50	20%	()
19. Barker's School Stories....	()	25%	\$3.75
20. David Harum.....	()	30%	\$1.05
21. Dickens's Works, 12 vol....	\$6.00	()	\$4.50
22. Kipling's Works, 15 vol....	\$15.00	()	\$10.00

INTEREST

241. PREPARATORY.

A borrowed \$500 of B for one year; at the end of the year he returned the \$500 and paid B \$6 per \$100 for the use of the money. How much did he pay for the use of the \$500?

242. A payment for the use of money is called **interest**. The rate of payment may be stated by naming the sum to be paid for the use of \$100 for one year.

243. Instead of saying "interest at the rate of \$6 per \$100 per year, or \$.06 per dollar," it is customary to say, "interest at the rate of 6% per annum," or, more briefly, "interest at 6%."

EXAMPLE: At the rate of 5% per year, what is the interest for 3 yr. on \$300?

Solution: (1) The interest on \$300 for 1 yr. is $.05 \times \$300 = \15 .

(2) For 3 yr. the interest is $3 \times \$15 = \45 .

ORAL EXERCISES

1. At the rate of 6% per year, what is the interest for 1 yr. on \$200? On \$500? On \$800? On \$1000? On \$2,000? On \$3,200?

2. What is the interest on \$100 for 1 yr. at 4%? On \$600? On \$3,200? On \$1?

3. What is the interest on \$1 for 1 yr. at 5%? At $3\frac{1}{4}\%$? At 6%?

4. At 5% per annum, what is the interest for 2 yr. on \$600? On \$800? On \$1000? On \$4,000? On \$6,800?

5. At 6% what is the interest on \$1 for 1 yr.? For 2 yr.? For 4 yr.? For 7 yr.? For 18 yr.?

6. At 3% what is the interest on \$100 for 1 yr.? For 5 yr.? For $\frac{1}{2}$ yr.? For $2\frac{1}{2}$ yr.? For $\frac{3}{4}$ yr.?

244. The sum of money bearing interest is usually called the **principal**.

WRITTEN EXERCISES

Find the interest on the following:

	1.	2.	3.	4.
Principal.....	\$200	\$250	\$483	\$1,500
Rate.....	4%	5%	6%	3%
Time.....	1 yr.	2 yr.	1 yr.	5 yr.

5. Which is the greater, the interest on \$100 for 3 yr. at 6%, or that on \$100 for 4 yr. at 5%?

6. A man borrowed money at 4% and lent it at 6%. How much did he make on \$10,000 in 5 yr. in this way?

7. What is the interest at 4% on \$500 for 5 yr.?

8. What is the difference in the annual income from \$8,600 when invested at 5% and at $4\frac{1}{2}\%$ interest?

9. How much does \$100 earn at 6% in one year? In 2 yr.? In 3 yr.? In 4 yr.? 5 yr.? 10 yr.? $15\frac{1}{2}$ yr.?

10. If \$100 has been on interest at 6% per annum long enough to earn \$27, how many years has it been lent?

11. How long must \$200 be on interest at 5% to earn \$20? \$50? \$35? \$15?

12. Mr. Todd bought a house for \$1,800. He had \$1,100 cash on hand and borrowed the rest from a friend to whom he agreed to pay interest at 5% per annum. How much interest did he pay for each year?

13. At the end of the first year Mr. Todd had saved \$185; he paid the interest due and paid the rest of his money to diminish the indebtedness. How much did he still owe? How much interest did he owe at the end of the second year?

245. The principal plus the interest for any given time is called the **amount** for that time.

EXAMPLE: What is the amount of \$750 at 6% for $5\frac{1}{2}$ yr.?

Solution: (1) 6% of \$750 = \$45.

(2) $5\frac{1}{2} \times \$45 = \247.50 .

(3) $\$750 + \$247.50 = \$997.50$, the amount.

WRITTEN EXERCISES

1. What is the amount of \$1,075 at 5% for 3 yr.? For 8 yr.? For 15 yr.?

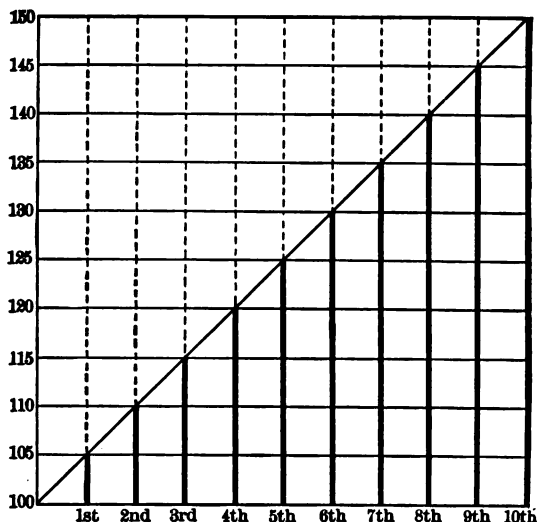
2. A man lent \$565 on a note for 3 yr. at $5\frac{1}{2}\%$. What was the amount of the note at the end of the 3 yr.?

3. The amount of a given principal for a certain time and rate was \$458, and the interest was \$79. What was the principal?

4. What is the amount of \$2,500 at $3\frac{1}{2}\%$ for 10 yr.? At 4% for 25 yr.?

ORAL EXERCISES

1. In the figure, each space between the horizontal lines represents \$5, and each space on these lines represents 1 year. The heavy lines represent the interest on \$100 at 5% for the



time indicated. How many dollars interest does the first heavy line represent? The second?

2. What interest does the fourth line represent? The tenth line?

3. The figures at the left express the *amounts* of \$100 for various years at 5%. What is the amount of \$100 for 2 yr. at 5%? What is the amount for 5 yr.? What is the amount for 8 yr.?

Read from the figure the interest on \$100 at 5% for :

	4.	5.	6.	7.	8.
Years.....	1	2	3	4	5

Read from the figure the number of years required to earn :

	9.	10.	11.	12.	13.
Interest	\$5	\$10	\$20	\$15	\$40

WRITTEN EXERCISES

1. Make a similar table for the rate 4%.
2. Find the amount of \$500 with interest at $5\frac{1}{2}\%$ for 7 yr.
3. Find the amount of \$375 with interest at $3\frac{1}{2}\%$ for 5 yr.
4. Find the amount of \$1,050 with interest at 4% for 16 yr.

Interest for a Fraction of a Year

246. PREPARATORY.

1. 6 mo. are what part of a year? 4 mo.? 3 mo.? 8 mo.? 9 mo.? 1 mo. is what part?

2. Express 2 mo. as a fractional part of a year. Also 4 mo. 6 mo. 8 mo. 10 mo.

3. In how many months would the interest on a sum of money equal that for $\frac{1}{4}$ yr. + $\frac{1}{4}$ yr.? That for $\frac{1}{3}$ yr. + $\frac{1}{4}$ yr.?

247. In computing interest, time expressed in months should be expressed as a fraction of a year.

WRITTEN EXERCISES

1. What is the interest on \$300 for 1 yr. at 4%? What is the interest for $\frac{1}{3}$ yr., or 4 mo.? For $\frac{1}{4}$ yr. + $\frac{1}{4}$ yr., or 5 mo.?

2. As in Exercise 1, find the interest on \$300 at 4% for 7 mo. For 11 mo. For 2 yr. 7 mo. For 3 yr. 11 mo.

What is the interest on \$800 at 3% for :

- | | | | |
|-----------|------------|-------------|-------------|
| 3. 1 yr.? | 6. 2 mo.? | 9. 3 mo.? | 12. 4 mo.? |
| 4. 5 mo.? | 7. 6 mo.? | 10. 7 mo.? | 13. 8 mo.? |
| 5. 9 mo.? | 8. 10 mo.? | 11. 11 mo.? | 14. 12 mo.? |

Find the interest on the following at 6%:

	15.	16.	17.	18.
Principal.....	\$200	\$250	\$600	\$880
Time.....	1 yr. 4 mo.	2 yr. 3 mo.	4 yr. 8 mo.	1 yr. 10 mo.

Find the interest on:

19. \$675 for 11 mo. at 4%.
20. \$500 for 3 yr. 9 mo. at 3%.
21. \$200 for 2 yr. 3 mo. at $3\frac{1}{4}\%$.
22. \$385 for 5 yr. 6 mo. at $4\frac{1}{2}\%$.
23. \$1,500 for 3 yr. 3 mo. at 4%.
24. \$325 from January 1, 1901, to Apr. 1, 1904, at 3%.
25. \$450 from May 1, 1909, to Sept. 1, 1909, at 4%.
26. \$218 from Apr. 1, 1909, to Aug. 1, 1911, at 3%.
27. \$550 from March 1, 1909, to Sept. 1, 1913, at $3\frac{1}{2}\%$.
28. \$600 from June 1, 1910, to Oct. 1, 1914, at $4\frac{1}{2}\%$.

BANKING

2902 BROADWAY.	No. <u>126</u>	New York <u>June 21</u> 1909
	The Corn Exchange Bank UNIVERSITY BRANCH.	
	Pay to the order of <u>James Carter</u>	
	<u>Thirty-five</u> \$ <u> </u> Dollars	
	\$ <u>35.00</u>	<u>Albert C. Arnold</u>

248. When money is deposited in a bank, the bank will pay the money, or any part of it, to any one who presents a written order from the depositor. Such an order is called a check.

Read the check. Who made it? On what bank was this order drawn? To whom did the bank pay the money? To whom did the money paid belong?

Checks may be transferred from one person to another, each person writing his name on the back of the check when he transfers it. Each person who thus signs his name is said to endorse the check.

The check is said to be *deposited* when it is handed into the bank for credit.

249. Blank checks are furnished by the banks in book form. When a check is filled out, it is detached from the book and sent to the bank or person to whose order it is drawn. The one issuing the check, called the **maker** of the check, should keep a record of the essential facts about it in the portion of the

No. <u>126</u> Date <u>July 1909</u>	AMOUNT	Date 1909. Deposits:	\$365.30
Pay to <u>J. Carter</u>	\$35.00	June 8 Cash	125.00
For <u>clothing</u>			
No. _____ Date _____ 190			
Pay to _____			
For _____			
No. _____ Date _____ 190			
Pay to _____			
For _____			
		Total Deposits	
		Checks Drawn	
Total		Balance	

book made for his purpose, as shown in the illustration. The deposits also may be entered as shown.

WRITTEN EXERCISES

1. In the account above find the total deposits shown on the right; also the balance after deducting the check.
2. A depositor had \$454.50 to his credit and drew the following checks: \$125, \$60.75, \$34.78, \$101.10. How much did he have left in the bank after the bank had cashed the checks?

3. A man opened an account with a bank and deposited \$500; later he drew by checks \$104, \$65.15, \$33.25, \$75.60. How much remained on deposit?

4. A merchant's deposits for one day were: cash \$235.15, checks \$360.84; his withdrawals were: cash \$110.50, checks \$290.35. What was the balance for the day?

Savings Accounts

250. Many banks receive savings deposits in sums from \$1 upward and pay interest thereon. The usual rules are:

a. Interest is computed semi-annually; January 1st and July 1st. Usual rates of interest are 3%, $3\frac{1}{2}\%$, and 4%.

b. Interest is not computed for fractions of a month, or on fractional parts of a dollar. Many banks do not compute interest for fractions of a quarter (3 months).

c. The interest when computed draws interest thereafter.

WRITTEN EXERCISES

1. Mr. Brown deposited \$50 on Jan. 5, and \$40 on Feb. 3. Find the amount of interest at 4% credited to him July 1 for the three months ending then, the bank not allowing interest on a part of a quarter year. How much had he on deposit July 1?

2. Mr. Hay deposited in the bank mentioned in Exercise 1: July 6, \$80; Sept. 23, \$125; Oct. 8, \$200; Nov. 1, \$150. How much interest was credited Jan. 1?

3. A depositor put \$235 in the same bank on Jan. 15 and withdrew \$105 on Feb. 10. How much interest, reckoned from March 1, was credited him on July 1 of the same year? How much had he on deposit then?

4. A man deposited \$375 on April 10 in a bank which pays interest at $3\frac{1}{2}\%$ from the 1st of the month following the date of deposit; on June 5 he deposited \$118.75. How much money had he to his credit Jan. 1 of the following year?

5. A man deposited \$15 in a savings bank regularly the first of each month, beginning July 1, 1909. The bank computed interest at 3% from the date of deposit. How much interest was credited Jan. 1, 1910? If he continued his deposits, how much interest was credited July 1, 1910? How much had he then on deposit altogether?

TAXES AND DUTIES

251. Cities, towns, counties, and states require their citizens to pay a sum of money each year for the support of schools, charitable institutions, public improvements, and many other common interests. Such a charge is called a **tax**.

252. Property is seldom taxed on its full value. The value fixed for the purpose of taxation is called the **assessed value**.

253. One tenth of a cent is sometimes called a **mill**, and the tax per dollar is usually expressed in mills.

Thus, a tax of $\frac{1}{4}$ of 1% is the same as $2\frac{1}{4}$ mills per dollar.

WRITTEN EXERCISES

1. A man's property is valued at \$4,000. If his school tax is $\frac{1}{4}$ of 1% of this amount, how many dollars is he taxed?

2. If a man's property valued at \$10,000 is assessed at $\frac{3}{4}$ of its full value, on how many dollars does he pay taxes?

3. If the tax in Exercise 2 is $2\frac{1}{4}$ mills on each dollar assessed, what are the man's taxes? What percentage of the assessed value are his taxes?

4. The board of a school district wishes to build a new schoolhouse costing \$1,500. If the assessed valuation of the property of the district is \$125,000, how much on every dollar must be collected in taxes to pay for the building?

5. According to Exercise 4, what tax will a man pay who owns property assessed at \$10,000?

6. What is the real value of the man's property mentioned in Exercise 5, if the assessment is $\frac{3}{4}$ of its value?

7. If the man who collects the tax receives 1% of the tax for his work, how much does the collector in Exercise 5 receive?

8. What is the collector's fee at 1% for collecting a tax of \$.002 per \$1 on an assessment of \$250,000?

254. The National Government does not tax land or personal property, but it taxes certain manufactured products; for example, alcoholic liquors and tobacco. Such charges are called **internal-revenue taxes**. A charge is made also on many articles brought into the country from foreign countries. Government charges levied on imported articles are called **customs, or duties**.

WRITTEN EXERCISES

1. If the tax on a gallon of wine of a certain brand is 30 cts., what is the tax on 1,700 gal.?

2. When the tax on a box of cigars of a certain brand is 20 cts., what is the tax on 25,000 boxes?

The duty on :

Carpets is.....	40%	Skein silk is.....	35%
Clothing is.....	50%	Silk fabric is.....	60%
Porcelain is.....	55%	Cotton garments is.....	25%
Flannels is.....	35%	Fur articles is.....	35%
Leather goods is.....	35%	Linen goods is.....	45%
Velvet is.....	15%	Oriental rugs is.....	40%

3. According to the table, what is the duty on 150 yd. of carpet worth 75 cts. a yard?

4. What is the duty on 35 yd. of silk at 95 cts. a yard?

5. What is the duty on an Oriental rug that cost \$250? On one that cost \$475?

6. Make and solve five other problems from the table.

7. In 1 yr. the United States Government received from:

LIQUORS	TOBACCO	STAMPS	MISCELLANIES
\$193,126,913	\$51,937,425	\$13,442,792	\$13,360,130

How much did it receive from all these sources?

8. From what source did it receive the most? The least? The amount received from liquors was how much more than that from tobacco? Than that from stamps?

9. What percentage of the total was from miscellaneous goods? What percentage was received from tobacco?

INSURANCE

255. Companies have been formed to afford protection (**insurance**) against financial loss by fire, storms, shipwreck, theft, injury by accidents, death, and the like.

256. The written or printed agreement that a company makes with a customer to reimburse him in case of loss is called a **policy**. The amount paid to the company for taking the risk is called the **premium**. This is usually stated at a rate per \$100 for a period of 1 or 3 yr.

WRITTEN EXERCISES

1. A man had his house insured for \$2,700 at \$1.10 per \$100. What is the premium?

2. What is the annual premium on a brick house valued at \$6,500, the rate being \$.45 per \$100?

Find the premiums for the following amounts of insurance at the specified rates:

3. House, \$1,550, contents for \$500, at \$1.05 per \$100.

4. House, \$3,400, contents for \$1000, at \$.95 per \$100.

5. House, \$2,500, contents for \$800, at \$.90 per \$100.

6. House, \$4,500, contents for \$1,500, at \$1.10 per \$100.

7. House, \$7,000, contents for \$3,000, at \$1.20 per \$100.

8. What is the annual premium for insuring a business block against loss by fire for \$9,000 at \$1.50 per \$100, its first-floor contents for \$5,000 at \$1.15 per \$100, and the other contents for \$3,500 at \$1.50 per \$100?

9. Find the premium for insuring a building valued at \$55,500 against damage by cyclones at \$1 per \$1000.

10. Find out about the rates of insurance in your locality, also the approximate value of some property. Find the premium that would be paid on the insurance of this property.

Rates of Insurance

257. Insurance rates are fixed by an association representing the various companies and vary with time and place.

TABLE OF INSURANCE RATES PER YEAR

SINGLE DWELLINGS AND CONTENTS	RATE PER \$100 INSURED
Brick.....	\$0.30
Brick veneered.....	0.40
Frame, detached, not less than 50 ft. on all sides.....	0.50
“ “ “ “ “ 25 “ “ “ “	0.60
“ “ “ “ “ 20 “ “ “ “	0.70
“ all others.....	0.75
Churches and contents, brick or stone.....	0.75
“ “ “ frame.....	1.00
SCHOOLHOUSES	
Brick or stone, with metal or slate roof.....	0.60
Brick or stone, with shingle roof.....	0.75
Frame.....	1.00

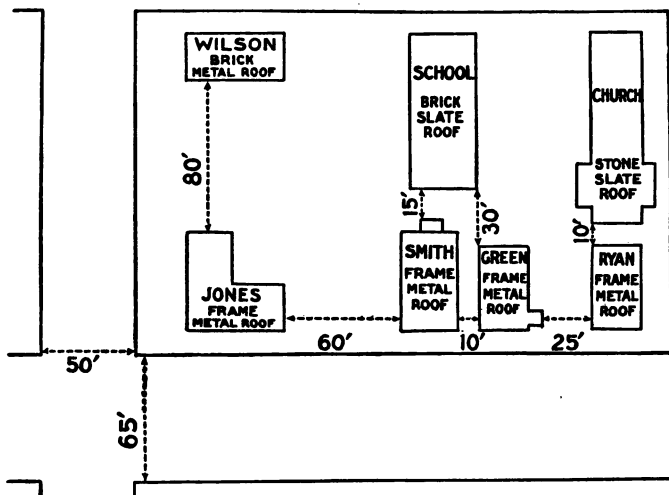
258. EXAMPLE: What is the premium for insuring for 3 yr. a frame dwelling, detached, not less than 25 ft. and valued at \$3,500?

Solution: (1) The rate for such a risk, as given in the table, is 60 cts. per hundred per year.

(2) $3 \times 35 \times \$60 = \63 , the premium.

WRITTEN EXERCISES

1. Using the table on page 208, find the premium for insuring the schoolhouse shown in the plan for \$10,000 for 5 yr.



2. Find the premium for insuring Mr. Ryan's house and its contents for \$3,300 for 2 yr.

3. Using the table, make and solve six other problems about the houses shown on the plan.

RENTS

259. Money paid for the use of houses, land, furniture, etc., is called **rent**. The property used is said to be rented.

260. A contract is usually signed, stating the time for which the property is rented, the amount of rental and the mode of payment, the responsibility of the renter for proper care of the property, etc. Such a contract is called a **lease**.

ORAL EXERCISES

1. According to the lease shown on page 211, to whom did Lewis Grant rent his property?
2. What was the total rental, and how paid, as stated at the end of the lease?
3. How much rent did Mr. Whitcomb pay annually?
4. B leased a house at \$750 per annum, payable monthly. How much was his rent per month?

WRITTEN EXERCISES

1. A lady rented a piano at \$4.50 per month; she paid \$4 for cartage and had the piano 6 mo. What was the total cost?
2. If the rent of a house is \$250 per year, how much is the rent per month? How much is the rent for 7 mo.? For 19 mo.?
3. A man arranged to rent a bicycle by the hour and to pay his bill monthly; the first month he used the wheel 162 hr. and paid \$16.20. What was the rate per hour? The second month he rode 117 hr., and the third month 78 hr. What was the amount of his bill for each month?
4. A merchant rented a block containing 2 stores and 4 suites of rooms for \$750 per year. He subrented one store for \$200 a year and each suite of rooms for \$8 a month. How much rent did the other store cost him per month?
5. An apartment-house contains 6 suites of rooms that rent for \$25 a week each, 10 suites that rent for \$75 a month each, and 5 that rent for \$60 a month. What is the total annual rental for the building?
6. Make up the items necessary to fill out a blank lease for a certain piece of property. Compute the rent named in the lease for 5 yr.

LEASE—SHORT.

10

6-08

It is Hereby Agreed, BETWEEN Swire Grant
 party of the first part, and Charles Whitcomb
 party of the second part, as follows: The said party of the first part, in consideration of the rents
 and covenants herein specified, do SA hereby **Let** and **Lease** to the said party of the second part, the
 following described premises, situated and being in the village of Uxarie
County of Uxarie and State of Michigan, to wit: house and lot No. 122
 for the term of five (5) years from and after the first day of April
1909 on the terms and conditions hereinafter mentioned, to be occupied for residence.

Provided, That in case any rent shall be due and unpaid, or if default shall be made in any of the
 covenants herein contained, then it shall be lawful for the said party of the first part SA
 certain attorney, heirs, representatives and assigns, to re-enter into, re-possess the said premises, and the
 said party of the second part, and each and every other occupant, to remove and put out.

And the said party of the second part do SA hereby hire the said premises for the term of
five (5) years as above mentioned, and do SA covenant and promise to pay to
 the said party of the first part, SA representatives and assigns, for rent of said premises for
 said term the sum of one thousand (1000) Dollars, the rent to be paid
 in equal annual installments.

Witness our hands and seals this tenth day of March 1909
Swire Grant
Charles Whitcomb

REVIEW**ORAL EXERCISES**

1. When goods costing \$50 are sold at a gain of 10%, how many dollars are gained by the transaction?

2. When \$25 is gained on the sale of goods which cost \$100, what is the rate per cent of gain?

3. A set of books was sold for \$120, at a gain of 20%. What did the books cost?

4. An agent received 5% commission for selling \$500-worth of butter. How many dollars did he receive?

5. An agent received \$35 for his services in selling a building lot; his rate of commission was 7%. For how much did he sell the lot?

6. The list price of an article was \$12.50, and the discount 20%. What was the net price?

7. What is interest? What does "interest at 6%" mean? What is the principal? The amount?

8. What is a bank check? Who is the maker of a check? Who may make checks to be paid by a bank?

9. What are taxes? By whom are taxes levied?

10. How is a small tax-rate usually expressed? What is meant by a tax-rate of $2\frac{1}{4}$ mills?

11. How does the United States Government levy taxes? Name some property that it does not tax. What are government taxes called?

12. What is insurance? What is the premium? What is meant by rate of insurance?

13. What is the insurance on property insured for \$20,000 for 3 yr., at \$.65 per \$100 per year?

14. How is a tax collector paid for his work?

WRITTEN EXERCISES

Find the gain or loss in each of the following :

COST	RATE OF GAIN	GAIN
1. \$500	16 $\frac{1}{2}$ %	()
2. \$350	28%	()
	RATE OF LOSS	LOSS
3. \$86.50	35%	()
4. \$195.75	15 $\frac{1}{2}$ %	()

Find the selling price :

COST	GAIN	COST	LOSS
5. \$40	16%	7. \$25.	16 $\frac{1}{2}$ %
6. \$120.50	18%	8. \$175.75	6%

Find the cost in each of the following :

SELLING PRICE	RATE OF GAIN	COST
9. \$165	10%	()
10. \$185	16 $\frac{1}{2}$ %	()
	RATE OF LOSS	
11. \$583.33	7 $\frac{1}{2}$ %	()
12. \$750.75	25%	()

Find the rate of gain or loss :

COST	SELLING PRICE	COST	SELLING PRICE
13. \$150	\$175	15. \$399.99	\$300
14. \$18.75	\$25	16. \$360	\$422.40

17. An agent received a commission of 6 $\frac{1}{2}$ % for selling 1000 bu. of potatoes at 50 cts. a bushel. How many dollars in his commission?

18. A collector received \$275 for collecting \$5,000. What was his rate of commission?

19. The list price of some chairs was \$6.30, subject to a 20% discount. What did a customer pay for 4 doz. of these chairs?

20. An agent remitted \$396 after deducting a commission of 10%. What was the amount of the collections on which he reckoned his commission?

21. A bill of \$875 was subject to a discount of 20%. How many dollars did it take to pay the bill?

22. The discount on a bill was \$162.50, resulting from an allowance of 25%. What was the amount of the bill?

23. What is the interest on \$675 for 11 mo. at 4%?

24. What is the interest on \$500 for 3 yr. 9 mo. at 3%?

25. What is the interest on \$200 for 2 yr. 3 mo. at $3\frac{1}{2}\%$?

26. A depositor had \$595.80 in the bank and drew, in checks, \$105.33, \$89.60, \$204.98. When these checks were paid, what was his balance?

27. What is the amount of a farmer's tax at 2 mills per dollar, whose farm, worth \$20,000, is assessed at $\frac{3}{4}$ of its value?

28. What is the duty on 17 cases of leather goods valued at \$5 per case when the duty is 35%?

29. If the school tax is $\frac{1}{4}$ of 1%, what is the school tax on property worth \$25,000?

30. What is the duty at 60% on 425 yd. of silk worth \$2.15 per yard?

31. What is the annual rent on a house whose rental is \$83.33 a month?

32. What is the premium for insuring property assessed for \$5,500, at $3\frac{1}{4}\%$?

33. When the rate of taxation is $2\frac{1}{4}$ mills per dollar and 1% for collecting, what does an owner pay on property assessed at \$35,000?

34. A school imported some laboratory instruments, billed at \$235.50, on which there was a duty of 1%. What was the total cost?

35. What is the interest on \$825 for 1 yr. 9 mo. at 4%?

GENERAL REVIEW

I

1. Name the first three periods in the numeration of integers.

2. Write in figures: Five million, three hundred eight thousand, two hundred thirty-six.

3. Write in words: 8,008,008.

4. Read: 905,006.0025.

5. Express in hundredths and thousandths: 84 thousandths (thus: 8 hundredths, 4 thousandths); 27 thousandths; 43 thousandths; 91 thousandths.

Write decimally:

6. 32 and 28 thousandths.

7. 19 thousandths.

8. 5 and 139 thousandths.

9. 1 and 1 thousandth.

10. Four hundred eight thousandths.

11. Four hundred and eight thousandths.

12. 9,352 thousandths.

13. 82 and 321 thousandths.

14. $\frac{1}{100}$; $\frac{5}{1000}$; $\frac{200}{1000}$; $\frac{25}{1000}$; $\frac{15}{1000}$; $\frac{286}{1000}$; $\frac{100}{1000}$.

Add and test:

15. \$37565	16. \$47826	17. \$268.42	18. \$827.99
16342	23247	127.80	777.85
98763	12835	988.75	676.90
47325	45626	878.29	788.75
66232	63412	144.35	425.50
83488	47856	800.20	100.83
24792	32883	723.00	676.97
<u>72687</u>	<u>73632</u>	<u>110.75</u>	<u>900.08</u>

Find the products of :

- | | | |
|-------------------------|--------------------------|---------------------------|
| 19. $2848 \times 27.$ | 23. $4978 \times .04.$ | 27. $88.3 \times 9.06.$ |
| 20. $4997 \times 36.$ | 24. $76.7 \times .23.$ | 28. $17.8 \times .87.$ |
| 21. $9832 \times 99.6.$ | 25. $23.4 \times 7.09.$ | 29. $40.91 \times 4.08.$ |
| 22. $.083 \times .046.$ | 26. $1.86 \times .0053.$ | 30. $.0096 \times .0009.$ |

Multiply :

- | | | | |
|--|--|--|--|
| 31. $\begin{array}{r} \$8056.23 \\ \underline{7.79} \end{array}$ | 33. $\begin{array}{r} \$1729.85 \\ \underline{29} \end{array}$ | 35. $\begin{array}{r} \$2799.87 \\ \underline{79.8} \end{array}$ | 37. $\begin{array}{r} \$1728.97 \\ \underline{34.6} \end{array}$ |
| 32. $\begin{array}{r} \$46.832 \\ \underline{.008} \end{array}$ | 34. $\begin{array}{r} \$72658 \\ \underline{.125} \end{array}$ | 36. $\begin{array}{r} \$7267.43 \\ \underline{8.7} \end{array}$ | 38. $\begin{array}{r} \$2897.8 \\ \underline{27.5} \end{array}$ |

Find the result to the nearest hundredth :

- | | | |
|----------------------|-------------------------|-----------------------|
| 39. $29.5 \div 7.5.$ | 42. $856.432 \div 1.6.$ | 45. $48.6 \div 2.7.$ |
| 40. $.029 \div 3.6.$ | 43. $72.80 \div 3,465.$ | 46. $14.2 \div 7.25.$ |
| 41. $.286 \div 86.$ | 44. $11.485 \div 2.8.$ | 47. $4.44 \div 8.85.$ |

Divide to the nearest thousandth and test :

- | | |
|---------------------------|----------------------------|
| 48. $\$237.66 \div 17.$ | 51. $\$6,934.25 \div .01.$ |
| 49. $\$70.616 \div .009.$ | 52. $\$3,692.73 \div .27.$ |
| 50. $2.456 \div 1.235.$ | 53. $.00325 \div 8.65.$ |

Add :

- | | | |
|---|---|--|
| 54. $\frac{4}{5} + \frac{7}{8} + \frac{2}{3}.$ | 58. $\frac{1}{2} + \frac{2}{3} + \frac{3}{4}.$ | 62. $\frac{1}{2} + \frac{1}{4} + \frac{3}{8}.$ |
| 55. $\frac{3}{4} + \frac{5}{8} + \frac{1}{2}.$ | 59. $\frac{4}{5} + \frac{3}{8} + \frac{1}{2}.$ | 63. $\frac{1}{18} + \frac{5}{18} + \frac{3}{4}.$ |
| 56. $\frac{1}{12} + \frac{4}{5} + \frac{3}{8}.$ | 60. $\frac{2}{3} + \frac{1}{8} + \frac{2}{5}.$ | 64. $\frac{5}{8} + \frac{4}{5} + \frac{1}{18}.$ |
| 57. $\frac{9}{10} + \frac{2}{3} + \frac{1}{4}.$ | 61. $\frac{1}{10} + \frac{2}{3} + \frac{5}{8}.$ | 65. $\frac{4}{5} + \frac{2}{3} + \frac{5}{8}.$ |

Subtract :

- | | | | |
|----------------------------------|-----------------------------------|----------------------------------|-----------------------------------|
| 66. $\frac{5}{8} - \frac{1}{3}.$ | 70. $\frac{3}{8} - \frac{1}{5}.$ | 74. $\frac{2}{3} - \frac{2}{5}.$ | 78. $\frac{1}{4} - \frac{1}{11}.$ |
| 67. $\frac{4}{5} - \frac{1}{4}.$ | 71. $\frac{4}{5} - \frac{2}{3}.$ | 75. $\frac{1}{3} - \frac{2}{5}.$ | 79. $\frac{1}{3} - \frac{1}{12}.$ |
| 68. $\frac{2}{3} - \frac{1}{2}.$ | 72. $\frac{1}{12} - \frac{1}{4}.$ | 76. $\frac{1}{3} - \frac{2}{5}.$ | 80. $\frac{1}{2} - \frac{3}{4}.$ |
| 69. $\frac{5}{8} - \frac{1}{3}.$ | 73. $\frac{1}{11} - \frac{2}{5}.$ | 77. $\frac{1}{3} - \frac{4}{5}.$ | 81. $\frac{1}{3} - \frac{3}{11}.$ |

$$\begin{array}{r} 82. 7\frac{1}{12} \\ \underline{7} \\ 18 \end{array}$$

$$\begin{array}{r} 83. 21\frac{3}{10} \\ \underline{18} \\ 10 \end{array}$$

$$\begin{array}{r} 84. 5\frac{1}{2} \\ \underline{3} \\ 6 \end{array}$$

$$\begin{array}{r} 85. 14\frac{7}{8} \\ \underline{3} \\ 8 \end{array}$$

$$\begin{array}{r} 86. 41\frac{5}{8} \\ \underline{12} \\ 14 \end{array}$$

Multiply:

87. $\frac{3}{4} \times \frac{2}{3}$.

92. $\frac{3}{8} \times \frac{1}{4}$.

97. $\frac{2}{3} \times \frac{1}{8}$.

102. $179\frac{3}{4} \times 14$.

88. $\frac{5}{6} \times \frac{1}{4}$.

93. $\frac{4}{5} \times \frac{3}{4}$.

98. $\frac{9}{17} \times \frac{2}{3}$.

103. $276\frac{1}{8} \times 23$.

89. $\frac{2}{3} \times \frac{5}{6}$.

94. $\frac{4}{11} \times \frac{2}{3}$.

99. $\frac{11}{12} \times \frac{5}{6}$.

104. $199\frac{1}{4} \times 35$.

90. $\frac{8}{9} \times \frac{1}{5}$.

95. $\frac{1}{10} \times \frac{3}{8}$.

100. $\frac{1}{3} \times \frac{3}{8}$.

105. $267\frac{1}{2} \times 28$.

91. $\frac{7}{8} \times \frac{5}{6}$.

96. $\frac{1}{3} \times \frac{1}{4}$.

101. $\frac{4}{5} \times 12$.

106. $100\frac{3}{8} \times 98$.

107. $340\frac{1}{2} \times 79$.

108. $40\frac{5}{8} \times 21\frac{3}{4}$.

109. $105\frac{2}{10} \times 55\frac{1}{2}$.

Divide:

110. $\frac{3}{8} \div 4$.

114. $\frac{2}{5} \div 7$.

118. $\frac{3}{14} \div \frac{1}{6}$.

122. $\frac{2}{13} \div \frac{4}{5}$.

111. $\frac{1}{8} \div 3$.

115. $\frac{5}{6} \div 6$.

119. $\frac{2}{22} \div \frac{2}{3}$.

123. $\frac{2}{3} \div \frac{2}{3}$.

112. $\frac{4}{4} \div 6$.

116. $\frac{1}{17} \div \frac{1}{3}$.

120. $\frac{1}{13} \div \frac{5}{4}$.

124. $\frac{1}{3} \div \frac{2}{3}$.

113. $\frac{3}{4} \div 5$.

117. $\frac{5}{12} \div \frac{1}{6}$.

121. $\frac{1}{11} \div \frac{4}{5}$.

125. $\frac{1}{13} \div \frac{4}{4}$.

126. $16\frac{3}{8} \div 12\frac{3}{4}$.

127. $48\frac{1}{11} \div 36\frac{1}{6}$.

128. $24\frac{3}{8} \div 7\frac{1}{2}$.

Express as mixed numbers:

129. $\frac{1}{7}$.

132. $\frac{201}{21}$.

135. $\frac{564}{18}$.

138. $\frac{384}{16}$.

141. $\frac{36}{8}$.

130. $\frac{4}{3}$.

133. $\frac{101}{11}$.

136. $\frac{863}{18}$.

139. $\frac{782}{8}$.

142. $\frac{26}{6}$.

131. $\frac{66}{8}$.

134. $\frac{186}{19}$.

137. $\frac{22}{4}$.

140. $\frac{426}{30}$.

143. $\frac{17}{2}$.

Reduce to improper fractions:

144. $112\frac{1}{3}$.

147. $106\frac{7}{12}$.

150. $201\frac{5}{12}$.

153. $604\frac{1}{4}$.

145. $87\frac{3}{4}$.

148. $29\frac{3}{7}$.

151. $180\frac{2}{3}$.

154. $501\frac{1}{3}$.

146. $40\frac{2}{10}$.

149. $56\frac{1}{2}$.

152. $200\frac{1}{2}$.

155. $133\frac{3}{8}$.

Add:

$$\begin{array}{r} 156. \quad 5 \text{ rd. } 16 \text{ ft. } 3 \text{ in.} \\ \quad 8 \quad 20 \quad 10 \\ \hline \end{array}$$

$$\begin{array}{r} 158. \quad 16 \text{ gal. } 3 \text{ qt. } 1 \text{ pt.} \\ \quad 20 \quad 2 \quad 1 \\ \hline \end{array}$$

$$\begin{array}{r} 157. \quad 10 \text{ mi. } 120 \text{ rd. } 12 \text{ ft.} \\ \quad 16 \quad 200 \quad 9 \\ \hline \end{array}$$

$$\begin{array}{r} 159. \quad 186 \text{ lb. } 12 \text{ oz.} \\ \quad 95 \quad 15 \\ \hline \end{array}$$

Subtract :

$$\begin{array}{r} 160. \quad 100 \text{ sq. yd. } 8 \text{ sq. ft. } 100 \text{ sq. in.} \\ \quad \quad \quad 56 \qquad \qquad 6 \qquad \qquad 110 \\ \hline \end{array}$$

$$\begin{array}{r} 161. \quad 148 \text{ cu. yd. } 24 \text{ cu. ft. } 1000 \text{ cu. in.} \\ \quad \quad \quad 75 \qquad \qquad 26 \qquad \qquad 908 \\ \hline \end{array}$$

Multiply :

$$\begin{array}{r} 162. \quad 10 \text{ gal. } 3 \text{ qt. } 1 \text{ pt.} \\ \quad \quad \quad 15 \\ \hline \end{array}$$

$$\begin{array}{r} 165. \quad 208 \text{ lb. } 12 \text{ oz.} \\ \quad \quad \quad 125 \\ \hline \end{array}$$

$$\begin{array}{r} 163. \quad 3 \text{ bu. } 2 \text{ pk. } 7 \text{ qt.} \\ \quad \quad \quad 18 \\ \hline \end{array}$$

$$\begin{array}{r} 166. \quad 12 \text{ rd. } 2 \text{ yd. } 2.5 \text{ ft.} \\ \quad \quad \quad 25 \\ \hline \end{array}$$

$$\begin{array}{r} 164. \quad 10 \text{ hr. } 40 \text{ min. } 20 \text{ sec.} \\ \quad \quad \quad 35 \\ \hline \end{array}$$

$$\begin{array}{r} 167. \quad 20 \text{ mi. } 60 \text{ rd. } 10 \text{ ft.} \\ \quad \quad \quad 64 \\ \hline \end{array}$$

Divide :

$$168. \quad 12 \overline{)16 \text{ rd. } 10 \text{ ft. } 8 \text{ in.}} \quad 170. \quad 15 \overline{)50 \text{ lb. } 10 \text{ oz.}}$$

$$169. \quad 12 \text{ ft. } 8 \text{ in.} \div 2 \text{ ft. } 4 \text{ in.} \quad 171. \quad 100 \text{ lb. } 12 \text{ oz.} \div 4 \text{ lb. } 14 \text{ oz.}$$

$$172. \quad 10 \text{ sq. yd. } 8 \text{ sq. ft. } 100 \text{ sq. in.} \div 3 \text{ sq. yd. } 4 \text{ sq. ft.}$$

Find the greatest common divisor of :

$$173. \quad 32, 36, 48, 128.$$

$$175. \quad 24, 256, 144.$$

$$174. \quad 108, 1728, 720.$$

$$176. \quad 40, 880, 711.$$

Find the least common multiple of :

$$177. \quad 12, 18, 80.$$

$$178. \quad 32, 72, 108.$$

Reduce to the form of a common fraction :

$$179. \quad .0065. \quad 181. \quad .1275. \quad 183. \quad .000075. \quad 185. \quad 6.25.$$

$$180. \quad 100.125. \quad 182. \quad .8025. \quad 184. \quad .20011. \quad 186. \quad .9009.$$

Reduce to a decimal of not more than 5 places :

$$187. \quad \frac{3}{8}. \quad 189. \quad \frac{5}{8}. \quad 191. \quad \frac{11}{16}. \quad 193. \quad \frac{11}{16}. \quad 195. \quad \frac{9}{11}. \quad 197. \quad \frac{111}{100}.$$

$$188. \quad \frac{5}{8}. \quad 190. \quad \frac{7}{16}. \quad 192. \quad \frac{5}{12}. \quad 194. \quad \frac{13}{18}. \quad 196. \quad \frac{5}{64}. \quad 198. \quad \frac{1}{1001}.$$

II

Solve :

1. A windmill grinds 5.2 bu. of corn per hour for 9 hr. and 45 min. How many bushels does it grind in this time?

2. When the air-pressure is 15 lb. per square inch, how many pounds pressure are there on a surface containing 8.75 sq. in.?

3. At 15 lb. per square inch, what is the air-pressure on the total surface of a book 4 in. by 6 in. by 1 in.?

4. How many cards 3 in. by 6 in. can be cut from 50 sheets of cardboard 18 in. by 24 in. in size?

5. In taking an account of stock, a merchant found that he had 4 pieces of silk costing 98 cts. per yard. The lengths of the pieces were: 7 yd. 1 ft. 10 in.; 12 yd.; 6 yd. 8 in.; 3 yd. 2 ft. Find the total number of yards and the cost of the whole.

6. Four cars together carry 240,676 lb. of granite. What is the average number of pounds per car?

7. In 1884 the export from the United States of iron and steel and articles manufactured from them amounted to \$21,900,000; in 1900 the value of the same exports was \$121,900,000. What was the difference between the values of the exports for the two years given?

8. The price of wheat was: Monday, \$.67 $\frac{1}{4}$; Tuesday, \$.68 $\frac{3}{4}$; Wednesday, \$.66 $\frac{1}{4}$; Thursday, \$.67 $\frac{1}{2}$; Friday, \$.67 $\frac{3}{8}$; Saturday, \$.66 $\frac{1}{4}$. Find the average price for the week.

9. From New York to Boston is 217 mi. How long does it take a train traveling 42 mi. per hour to go from New York to Boston? Express the result to .01 of an hour.

10. A train goes 12 mi. in 16.4 min. What is the speed per minute to the nearest .01 of a mile?

11. What fraction of 1 sq. yd. are 12 sq. in.? 144 sq. in.? 156 sq. in.? 288 sq. in.?

12. How many window-curtains $\frac{3}{4}$ yd. long can be cut from a piece of goods 30 yd. long?

13. How many are 20% of 300? Of 500? Of 1,700?

14. How many are 60% of 400? Of 4,000? Of 6,400?

15. How many are 5% of 700? Of 100? Of 900?

16. How many are 100% of 100? Of 900? Of 70? Of 3?

17. How many are 150% of 100? Of 200? Of 400?

18. How many are 200% of 100? Of 200? Of 80? Of 5?

19. A workman received \$12 per week of 6 working days. His wages were raised to \$14.40 per week. How much was the increase per day? How many per cent?

20. A mailing clerk was to address circulars according to a certain list. After having addressed 3,200, he had not copied $\frac{1}{4}$ of the names on the list. How many names were there?

21. If a savings-bank pays interest at 2% semiannually, what is the interest on a deposit of \$100 for $\frac{1}{2}$ yr.? Add the interest to the deposit and find the interest for the next $\frac{1}{2}$ yr.

22. What is the cost of 1 dozen pairs of lace curtains at 98 cts. a pair?

23. What is the cost of 15 yd. of muslin at 11 cts. a yard and 24 yd. of gingham at 9 cts. a yard?

24. What is the cost of 5 lb. of spring chicken at 18 cts. a pound and 13 lb. of pork at 11 cts. a pound?

25. What is the cost of 101 boxes of soap at \$2.75 a box?

26. What is the cost of 3 shirt-waists at 99 cts. each and 4 pairs of gloves at 98 cts. a pair?

27. What is the cost of 5 lb. of coffee at 29 cts. a pound and 9 lb. at 19 cts. a pound?

28. How much do 11 yd. of carpet cost at 79 cts. per yard?

29. What is the area of a square 21 in. on a side?

30. How many miles does a train run in 18 hr. at the rate of 31 mi. per hour?

31. How many miles does an automobile travel in 11 hr. at the rate of 21 mi. per hour?

32. What is the weight of a load of apples containing 22 bbl., if each barrel of apples weighs 130 lb.?

33. How many square rods are there in a field 17 rd. long and 9 rd. wide?

34. 20% of potatoes is water. How many pounds of water are there in 100 lb. of potatoes? In 500 lb.? In 250 lb.?

35. 1% of flour is fat. How many pounds of fat are there in 200 lb. of flour? In 150 lb.? In 500 lb.? In 625 lb.?

36. 37% of mutton is fat. How many pounds of fat are there in 500 lb. of mutton?

37. The distance from New York to San Francisco is about 3,300 mi. By how many inches is this distance represented on a map whose scale is 1 in. for every 100 mi.? From New York to Chicago is about 1000 mi. What is the distance on the map between these places?

38. If a barometer reads 30 in. on 3 days in a week, 29.5 in. on 2 other days, and 30.1 in. on 2 others, what is the average height for the week?

39. If the thermometer registers 70° one day, 75° the next, and 84° the next, what is the average temperature for the three days?

40. Two men engage in business; one furnishes \$40,000, and the other \$60,000. What is the ratio of their capitals? They gain \$6,000 in one year, which is shared in the ratio of their capital. How many dollars does each receive?

41. The average daily paid circulation of a newspaper is 95,000. If the average receipts for one day are \$1,900, what is the price per copy?

42. How many feet of inch boards will be necessary to build a sign-board 40 ft. long and 12 ft. high? What will the lumber cost at \$6 per thousand feet?

43. If a fan having 16 rays opens out so that the outer rays form a straight line, how many degrees are there between any two adjacent rays?

44. A house costing \$24,000 rents for \$1,200. The taxes and expenses are \$300 per year. What is the annual rate per cent of income on the investment?

45. How many years, months, and days were there from the assassination of President Lincoln, April 14, 1865, to that of President McKinley, Sept. 7, 1901?

46. The silkworm larvæ from 1 oz. of eggs produce, under ordinary conditions, about 130 lb. of cocoons. With special care the product may be increased by $33\frac{1}{3}\%$. To how many pounds would the total be equal?

47. How many acres are there in a farm $1\frac{1}{2}$ mi. long and $\frac{3}{4}$ of a mile wide?

Find the interest at 4% on :

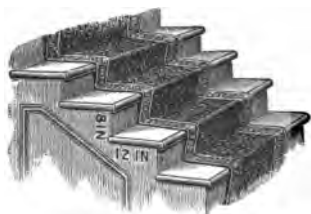
48. \$1000 for 2 yr. 6 mo.

50. \$285 for 4 yr. 4 mo.

49. \$500 for 5 yr. 3 mo.

51. \$675.50 for 3 yr. 11 mo.

52. How many yards of carpet $\frac{3}{4}$ yd. wide must be bought to cover the floor of a room $3\frac{1}{4}$ yd. by 5 yd., the strips running the long way, and $1\frac{1}{2}$ yd. being allowed for matching?



53. There are 14 steps to the stairs shown in the picture. What did the carpet cost at 60 cts. a yard?

54. The "East Room" at the White House is 82 ft. \times 40 ft.

Find the cost of carpeting it with carpet 27 in. wide at \$3 a yard.

55. Suppose that in your State 70% of the area is under cultivation and that there are 4 insect-eating birds per acre. If each bird eats 12 injurious insects per day, how many insects are killed weekly by the birds in your State?

56. Before the Spanish-American War, Spanish exports to Cuba amounted to 136 million dollars, to Porto Rico 44 million dollars, to the Philippines 49 million dollars; in 1901 the exports to these places fell to 66 million, 13 million, and 27 million dollars, respectively. What was the per cent of reduction in each case?

57. In Minnesota and in the Dakotas 15 million acres are given to raising wheat. If, by using a new variety of seed, the present yield of 27 bu. per acre is increased 2 bu. an acre, what will be the annual crop in these 3 States? At 75 cts. per bushel, what will be the increase in the value of the wheat-crop by the use of the new seed?

58. In a Fall River cotton-mill 58 hr. are considered a week's work; the average wage paid is \$7.50 a week, which is increased $\frac{1}{10}$ by the profit-sharing plan. What is the complete average wage per day? Per hour?

59. Of the 800 employees in a soap factory 325 are boys; the average wage for men is \$10 a week, and for boys \$5.50. What is the amount of the weekly pay-roll?

60. In a house using 6 Welsbach burners and 6 common burners, the gas costs 3 cts. an evening for each common burner and $1\frac{3}{4}$ cts. for each Welsbach. How much less does the gas for the Welsbach burners cost during a month?

61. If pure air contains 20.04% of oxygen, how many cubic inches of oxygen are there in 1 cu. ft. of air? If 70.02% of pure air is nitrogen, how many cubic inches of nitrogen are there in 1 cu. ft. of air? If the remainder is carbonic-acid gas, what rate per cent of air is carbonic acid gas?

62. If sound travels 1000 ft. per second when the temperature is 32° Fahr., how many seconds after firing will the report of a cannon be heard at a point 4 mi. distant?

63. Sound travels 4 times as fast in water as in air. According to the rate given in Exercise 62, how many seconds will it take sound to travel a mile in water? How long will it take it to travel $11\frac{3}{4}$ mi.?

64. A railroad train crosses a bridge $\frac{1}{2}$ mi. long at a speed of 15 mi. per hour. In how many minutes does the engine pass over the bridge?

65. How many bricks $4\frac{1}{2}$ in. by 9 in. are required to pave a passageway $4\frac{1}{2}$ ft. wide and 120 ft. long? What is the cost of the bricks at \$6.75 per thousand?

66. How many feet are there in a mile? How many inches? If an inch on a map represents 100 mi., 3 mi. are represented by what part of an inch? Make a problem involving map measurement and time.

67. If the area of the island of Cuba is 46,000 sq. mi. and that of New York State 49,000 sq. mi., find the ratio of the latter to the former.

68. Make problems from the following data:

NAME.	DATE OF BIRTH.	NAME.	DATE OF BIRTH.
James Madison....	Mar. 16, 1751.	Geo. Washington..	Feb. 22, 1732.
J. G. Whittier.....	Dec. 17, 1807.	H. W. Longfellow..	Feb. 27, 1807.

69. It has been estimated that during some storms the waves on Lake Michigan strike the shore with a force equal to 6,000 lb. per square foot and average 20 ft. in height. With what force does such a wave strike a wall 100 ft. long and 30 ft. high?

70. In a certain total eclipse the sun was completely covered at 2 o'clock 47 min. 23 sec. and reappeared at 2 o'clock 50 min. 48 sec. What was the length of the total eclipse?

71. If slates cost \$12.40 per thousand, and if 4 slates are required per square foot, what is the cost of slates for a roof 54 ft. along the ridge and 20 ft. down the slope?

72. The total liabilities of all the business houses failing in a given year were \$45,376,472, $\frac{1}{3}$ of which belonged to grocers. How many dollars were their liabilities?

73. What will be the cost of plastering a 10-room house, the rooms averaging 4 yd. by 5 yd. and 3 yd. high, at 15 cts. per square yard?

On account of the extra work around windows and doors, masons seldom make any allowance for these areas in estimating the cost of the work.

74. Find the average rainfall for San Diego for the six months given in the table:

PLACE.	DEC.	JAN.	FEB.	MAR.	APR.	MAY.
San Diego, Cal....	2.34	1.96	2.36	1.47	0.87	0.36
San Francisco.....	5.11	4.98	3.72	3.28	2.14	0.68
Sitka, Alaska.....	10.11	9.75	10.51	10.02	6.24	4.94
Salt Lake City.....	1.59	1.52	1.38	1.92	2.36	1.78
New York.....	3.33	3.89	3.76	4.10	3.40	3.05

Similarly, find the average rainfall for each of the other places named.

75. When the wind blows 15 mi. per hour the power of a windmill is sufficient to grind about $46\frac{1}{2}$ bu. per hour. How many bushels would it grind in 87 days of 10 hr. each?

76. Three brothers owned an apartment building jointly, all having equal shares. One sold $\frac{3}{8}$ of his share to his cousin. What fraction of the building did the cousin own?

77. They sold the building for \$18,000. How much did each receive?

78. Find in square feet the area of a rectangle the length of whose base is $\frac{3}{4}$ ft. and whose altitude is $\frac{3}{4}$ ft.

79. What is the ratio of the population of Tennessee, 2 millions, to that of the United States, 76 millions? Of Texas, 3 millions, to that of the United States?

80. If $\frac{1}{4}$ of wheat flour is water, how much water is there in a barrel (196 lb.) of flour?

81. On Oct. 1 a gas meter read 34,800 cu. ft.; on Nov. 1 it read 39,400 cu. ft. How many cubic feet of gas passed through the meter in the interval? What did it cost at \$1.20 per thousand feet?

82. A screw with 9 threads to the inch is being driven into a board. How many turns are necessary to drive the screw $1\frac{1}{2}$ in. into the board?

83. What is the weight of 10 baskets of coal each weighing 84.7 lb.?

84. A house cost \$2,175; the lot on which it stands cost .2 as much. How many dollars did the lot cost?

85. From a log 35 ft. long a length of 17 ft. 8 in. was cut. How long was the piece that was left?

86. There are 100 small cartridges in a box. How many are there in $\frac{25}{100}$ of a box? In $\frac{1}{4}$ of a box? In $\frac{75}{100}$ of a box? In $\frac{3}{4}$ of a box?

87. A rectangular desk is 5 ft. 8 in. long and 28 in. wide. How many feet of molding are required to go once around the desk?

88. A letter-carrier walks $\frac{2}{3}$ mi. on his first trip, $\frac{2}{8}$ mi. on the second, and $\frac{2}{8}$ mi. on the third. How far does he walk altogether? Express the result as a mixed number.

89. At \$1.25 per thousand feet, what is the cost of 5,000 ft. of gas?

90. How many acres are there in a rectangular piece of land 1 mi. wide and 15 mi. long?

91. Find the cost of $4\frac{1}{2}$ lb. of steak at 18 cts. per pound, 3 doz. cookies at 12 cts. a dozen, $2\frac{3}{4}$ lb. of butter at 24 cts. per pound.

92. The expenses of conducting the Library of Congress in 1 year were: \$384,185 for cost of service; \$91,300 for books; \$45,000 for furniture; \$95,000 for printing and binding. What were the total expenses?

93. Find the cost of 550 ft. of joists at \$22 per thousand feet.
94. \$276 was paid for nails at 2.3 cts. per pound. How many pounds were bought? How many tons?
95. At 1.9 cts. per mile, the fare from New York to Chicago by a certain route would be \$17.35. Find the distance.
96. How many rods of fence will enclose a quarter-section?
97. How many feet of 6-inch boards are required to make a fence 4 boards high around a quarter-section?
98. How many steps $\frac{1}{4}$ of a yard long does a man take in walking 5 mi.?
99. A man wishes to plant a hedge about his lot, which is 101 ft. by 200 ft; the hedge is set in 1 ft. from the boundary of the lot; his plants cost \$5 a hundred and are set out 3 per foot; he pays a man 2 cts. apiece for setting out the plants. What does it cost him to plant the hedge?
100. Draw a rectangle of length 10 in. and width 5 in. Shade 60% of it. Shade 95% of it.
101. From a rectangular piece of cloth 8 in. wide and $7\frac{1}{2}$ in. long are cut without waste 2 rectangular pieces 2 in. wide and $7\frac{1}{2}$ in. long, one rectangular piece $2\frac{1}{2}$ in. wide and 4 in. long, one right-angled triangle with base 4 in. and altitude 4 in., and one trapezoid with bases 1 in. and 5 in. What is the altitude of the trapezoid, and what is its area?
102. A boy stands so as to face the east and turns to the left through 90° . What point does he face? If he turns through 180° , what point does he face? Through 270° ? If he turns to the right through 90° ? Through 180° ?
103. Through how many degrees does the hour-hand of a watch turn between 12 o'clock and 4 o'clock? Between 2 o'clock and 7 o'clock?
104. If a man receives 75 cts. a 4-foot cord for cutting wood and 50 cts. a 4-foot cord for sawing it into 16-inch stove wood, what is the cost of cutting 125 cords of stove wood?

105. A commission merchant sold 150 bu. of peaches at \$2.25 per bushel; his rate of commission was $4\frac{1}{2}\%$. What was his commission?

106. What is meant by a $2\frac{1}{4}\%$ grade? A 6% grade? A $7\frac{1}{2}\%$ grade?

107. At a special sale a firm offered goods as follows:

Marked price.....	\$3.75	\$14	\$59	\$87	\$99
Discount.....	10%	$16\frac{2}{3}\%$	20%	3%	$5\frac{1}{2}\%$

Find the reduced price.

108. Three ships leave port on the same day, January 1; the first returns regularly every 20 days, the second every 22 days, and the third every 28 days. What is the least number of days after January 1 before all three boats will leave port again on the same day?

109. A foundation wall is 45 ft. by 120 ft., outside measurement, 18 in. thick, and 8 ft. deep. Find the number of cubic yards of masonry in the wall?

110. How many rolls of paper 18 in. wide, which cuts five 8-foot strips to the roll, is required to paper the side walls of a room 12 ft. by 18 ft., allowing 15% of the surface for windows and doors?

111. Bulky goods are usually shipped by freight. The charge is made per 100 lb., and articles are grouped in different classes according to bulk and character, with different rates. What is the freight charge on a shipment of 125 lb. from Chicago to Boston at 82 cts.?

112. On a shipment of 248 lb.? Of 850 lb.? Of 1,240 lb.?

113. What is the freight charge on 1,275 lb. from New York to Galveston at \$1.65?

114. Between Boston and Chicago, and frequently between other places, freight shipments weighing less than 100 lb. are charged as 100 lb., irrespective of weight. By express the rates are as follows:

Rate per 100 pounds, \$2.50; for smaller weights:

Weight.....	1 lb.	2 lb.	3 lb.	4 lb.	5 lb.	7 lb.	10 lb.
Charge.....	\$0.25	\$0.30	\$0.45	\$0.50	\$0.55	\$0.65	\$0.75
Weight.....	15 lb.	20 lb.	25 lb.	30 lb.	35 lb.	40 lb.	50 lb.
Charge.....	\$0.80	\$0.90	\$1.00	\$1.10	\$1.20	\$1.25	\$1.25

Parcels weighing 50 lb. and over are charged at the rate of 2½ cts. per pound. Weights between those named in the table are charged for at the rate for the next higher weight.

This being the case would it be cheaper to send a 6-pound parcel by freight or by express?

115. Which would be cheaper in the case of 10-pound parcel? A 30-pound parcel? A 38-pound parcel? A 70-pound parcel? A 100-pound parcel?

116. In the preceding exercises no account has been taken of the fact that express charge includes calling for the parcel and delivering it, and that the freight charge includes neither. If 25 cts. is paid for cartage at each end of the route when a parcel is shipped by freight, what is the largest weight that can be sent more cheaply by express than by freight?

117. Mr. Henderson of Boston orders a 25-pound lot of paper from Chicago; it is sold f. o. b. (delivered *free on board*) in Chicago; the cartage in Boston will cost Mr. Henderson 30 cts. Is it cheaper to have the paper sent by express or by freight and how much cheaper?

118. When the freight rate is 95 cts. per 100 lb. and the cartage at each end is 40 cts., what is the total cost of transportation of a box of books weighing 350 lb.?


119. When the freight rate is 60 cts. per 100 lb. and shipments weighing less than 100 lb. are charged as 100 lb., how much is saved by making one shipment of three 90-pound packages instead of a separate shipment for each?

120. If convenient, ascertain the freight rates from your city to several others and make problems about them.

121. The following is the ordinary form of a gas bill:

It is requested that the amount of the bill be promptly sent to this Office if not paid to the Collector when rendered.

C. H. Norton, 200 West 121st Street.	
To Consolidated Gas Company of New York, Br. BRANCH OFFICE, 2084 THIRD AVENUE.	
For Gas Supplied from October <u>17</u> to November <u>18</u> 1909.	Cts.
Present State of Meter <u>170.00</u>	<u>3.50</u>
Previous State of Meter <u>135.00</u>	
To Supply of <u>36.00</u> cubic feet of Gas	
OFFICES ALSO AT { 139 WEST 128th STREET, 1911 AMSTERDAM AVE., NEAR 86th ST.	
Received payment _____	



What was the rate charged per cubic foot?

122. The burners in a house consumed the following number of feet of gas in each month named:

Jan.	Feb.	Mar.	Apr.	May	June
2,800	3,000	2,800	2,400	1,600	1,800

How many thousand feet were consumed in the six months?

What was the cost at \$1 per 1000 ft.?

123. Meters for measuring gas are usually subject to error. If the meter which measured the gas billed in Exercise 122 read 2.5% too much, what correction should be made in the gas bill?

124. Find the amount of the following gas bill at 80 cts. per 1000 ft.:

Previous state of meter 106,900 ft.

Present state of meter 129,500 ft.

125. If an ordinary gas-burner consumes 7 ft. of gas per hour, and a Welsbach burner consumes 4 ft. per hour, how much would two burners, one of each kind, consume in 10 hr.?

126. When gas costs \$1 per 1000 ft., how much is saved per hour by the use of a Welsbach burner? Per day of 6 hr.? Per month of 30 da. at the same rate?

DENOMINATE NUMBERS

TABLES

Linear Measure

12 inches (in.)	= 1 foot (ft.)
3 feet	= 1 yard (yd.)
16.5 feet	= 1 rod (rd.)
320 rods	= 1 mile (mi.)
1760 yards	= 1 mile
5280 feet	= 1 mile
6 feet	= 1 fathom

Measure of Time

60 seconds (sec.)	= 1 minute (min.)
60 minutes	= 1 hour (hr.)
24 hours	= 1 day (da.)
7 days	= 1 week (wk.)
365 days or	
12 months (mo.)	= 1 year (yr.)
10 years	= 1 decade
10 decades	= 1 century

Liquid Measure

4 gills (gi.)	= 1 pint (pt.)
2 pints	= 1 quart (qt.)
4 quarts	= 1 gallon (gal.)
231 cu. in.	= 1 gal.
31½ gal.	= 1 bbl.

Counting

12 units	= 1 dozen (doz.)
12 dozen	= 1 gross (gro.)
12 gross	= 1 great gross (gt. gro.)
24 sheets of paper	= 1 quire
20 quires, or 480 sheets,	= 1 ream

Dry Measure

2 pints (pt.)	= 1 quart (qt.)
8 quarts	= 1 peck (pk.)
4 pecks	= 1 bushel (bu.)
32 quarts	= 1 bu.
2150.4 cu. in.	= 1 bu.

Avoirdupois Weight

7000 grains (gr.)	= 1 pound (lb.)
16 ounces (oz.)	= 1 pound
100 pounds	= 1 hundredweight
2000 pounds	= 1 ton (t.)
2240 pounds	= 1 gross ton

Square Measure

144 square inches (sq. in.)	= 1 square foot (sq. ft.)
9 square feet (sq. ft.)	= 1 square yard (sq. yd.)
30¼ sq. yd.	= 1 square rod (sq. rd.)
160 sq. rd.	= 1 acre (A.)
640 acres	= 1 square mile (sq. mi.)
1 sq. mi.	= a section
36 sq. mi.	= a township
100 sq. ft.	= a square (of roof, etc.)

Surveyors' Measures of Length

7.92 inches	= 1 link (li.)
100 links	= 1 chain (ch.)
80 chains	= 1 mile

The public lands of the United States are surveyed by the chain.

Surveyors and engineers now generally use a steel tape graduated in feet and inches or in feet and tenths of a foot.

United States Money

10 cents (¢)	= 1 dime
10 dimes	= 1 dollar
100 cents	= 1 dollar (\$)
10 dollars	= 1 eagle
20 dollars	= 1 double eagle

Angular Measure

60 seconds (")	= 1 minute (')
60'	= 1 degree (°)
90°	= 1 right angle (rt. ∠)
180°	= 1 straight angle (st. ∠)
360°	= 4 right angles

Cubic Measure

1728 cubic inches (cu. in.)	= 1 cubic foot (cu. ft.)
27 cubic feet (cu. ft.)	= 1 cubic yard (cu. yd.)
128 cubic feet	= 1 cord
1 cubic yard	= 1 load (of earth, etc.)
24½ cubic feet	= 1 perch (stone)

Apothecaries' Weight

20 grains (gr.)	= 1 scruple (sc. or ℥)
3 scruples	= 1 dram (dr. or ℥)
8 drams	= 1 ounce (oz. or ℥)
12 ounces	= 1 pound (lb.)
5760 grains	= 1 pound

The table of apothecaries' weight is used by pharmacists in selling drugs at retail.

Troy Weight

24 grains (gr.)	= 1 pennyweight (pwt. or dwt.)
20 pennyweights	= 1 troy ounce
12 troy ounces	= 1 troy pound
480 grains	= 1 troy ounce
5760 grains	= 1 troy pound

Troy weight is used in weighing precious metals.

INDEX

Accounts, 40.
Addends, 17.
Addition, 2, 17, 69, 103.
Altitude, 136.
Amount, 199.
Angular Measure, 128.
Approximating Results, 153.
Assessed Value, 205.
Area, 136.

 of Rectangle, 136.
 of Square, 136.
 of Parallelogram, 136.
 of Triangle, 138.
 of Trapezoid, 139.

Balancing, 40.
Banking, 202.
Base, 136.
Bills, 10, 108.
Board Foot, 147.
Business Arithmetic, 10, 192.
 Gain and Loss, 192.
 Commission, 194.
 Trade Discount, 196.
 Interest, 197.
 Banking, 202.
 Savings Accounts, 204.
 Taxes and Duties, 205.
 Insurance, 207.
 Rents, 209.

Cancellation, 53.
Capacity, Measure of, 121.
 Equivalents, 145.

Carpeting, 142.
Cash Accounts, 40.
Check, Bank, 202.
 Maker of, 203.
Commission, 194.
Comparison, 63.
Complex Fractions, 93.
Compound Numbers, 121.
Counting, 125.
Cube, 10.
Cubic Measure, 126.
Customs, 206.

Dates, Difference between, 149.
Decimals, 6, 99, 170.
 Tenths and Hundredths, 99.
 Tenths' Place, 99.
 Hundredths' Place, 99.
 Thousandths, 101.
 Thousandths' Place, 101.
 Addition and Subtraction, 103.
 Multiplication, 105, 107, 174.
 Division, 111, 176.
 Reduction, 114, 171.
 Equivalents, 115.
Denominate Numbers, 8, 121.
 Reduction, 130.
 Reduction Descending, 130.
 Reduction Ascending, 131.
 Addition and Subtraction, 131.
 Multiplication, 133.
 Division, 134.
 Applications of, 136.
 Tables, 231.

- Denominator, 59.
 - Common, 67.
 - Least Common, 68.
- Difference, 20.
- Discount, 196.
- Dividend, 32.
- Divisibility, 47.
- Division, 5, 32, 111.
 - by 10 and 100, 35.
 - long, 37.
 - of Dollars and Cents, 39.
- Divisors, 32, 48.
 - Common, 49.
 - Greatest Common, 50.
- Dry Measure, 121.
- Duties, 206.
- Factoring, 48.
- Factors, 25, 47, 48.
- Fractions, 6, 59.
 - Terms, 59.
 - Proper and Improper, 61.
 - Complex, 93.
 - Reduction, 64, 171, 172.
 - Addition, 69.
 - Subtraction, 71.
 - Multiplication, 77.
 - Division, 86.
- Gain and Loss, 192.
- Graphs, 165.
- Hundreds, 15.
- Hundred-millions, 15.
- Insurance, 207.
 - Rates of, 208.
- Integers, 15, 79, 111.
- Interest, 197.
- Internal-revenue, 206.
- Keeping Store, 44.
- Land Measure, 141.
 - Section, 141.
- Linear Measure, 126.
- Liquid Measure, 121.
- List Price, 196.
- Long Division, 37.
- Lumber, Measure of, 146.
- Making Change, 22.
- Masonry, 148.
- Mill, 205.
- Million, 15.
- Minuend, 21.
- Mixed Numbers, 61.
 - Addition and Subtraction of, 74.
 - Multiplication of, 83.
 - Division of, 90.
- Money Orders, 42.
- Multiples, 26, 51.
 - Common, 51.
 - Least Common, 51.
- Multiplicand, 25.
- Multiplication, 4, 25, 105.
 - by 10 and 100, 27.
 - of Dollars and Cents, 29.
- Multipliers, 25, 47.
 - Containing Zeros, 28.
- Net Price, 196.
- Notation, 1, 15, 99, 170.
- Numbers, 20.
 - Like and Unlike, 20.
 - Concrete and Abstract, 26.
 - Odd and Even, 47.
 - Prime and Composite, 48.
- Numeration, 1, 15, 99, 170.
- Numerator, 59.
- Orders, 15.
- Papering, 142.
- Parallelogram, 136.

- Parts of Numbers, 91, 92.
Percentage, 170, 178.
 Per Cent of a Number, 180.
 Per Cent One Number is of Another, 182.
 Finding a Number from a Percentage, 184.
Periods, 15.
Policy, 207.
Postage Problems, 46.
Powers, 30.
 Second Power, 30.
 Third Power, 30.
Premium, 207.
Principal, 198.
Product, 25.

Quotient, 32.

Rate Per Cent, 178.
Ratio, 160.
Rectangle, 136.
 Rectangular Solids, 144.
Reduction, 64, 114.
 to Higher Terms, 64.
 to Lower Terms, 64.
 to Lowest Terms, 66.
 to Common Denominator, 67.
Remainder, 20, 33.
Rents, 209.
Review, 1, 54, 94, 117, 168, 186, 212, 215.

Savings Accounts, 204.
Shingling, 142.
Signs,
 of Addition and Subtraction, 3, 17.
Signs (*continued*).
 of Equality, 3.
 of Multiplication, 4, 25.
 of Division, 5.
Solution of Problems, 154.
Square, 30, 136.
Square Measure, 126.
Subtraction, 2, 20, 69, 103.
Subtrahend, 21.
Sum, 17.
Surface Measure, 136.

Tax, 205.
Taxes and Duties, 205.
Ten-million, 15.
Tests, 21, 33, 154.
Thousands, 15.
Time, Measure of, 125.
Township, 141.
Trade Discount, 196.
Trapezoid, 139.
Triangle, 138.

Units, 15.
Unit Fraction, 60.
Unitary Analysis, 156.
United States Money, 123.
Use of Letters, 163.

Value, Measure of, 122.
Volume, 144.

Weight, Measure of, 122.
 Avoirdupois, 122.
 Troy, 123.
 Apothecaries, 123.
Wood, Measure of, 146.

ERRATA

Since the first printing of the Appleton Arithmetics, Second Book, a considerable number of problems have been changed in revising data or in correcting misprints, or in making desirable improvements. The following list of changes in the Answers to the problems in the book is the result of all changes made in the problems themselves, and of such typographical errors and incorrect results as have been discovered.

The original answer should be consulted first in all cases. If questionable, then refer to the errata list to see if a new form is given. Owing to the fact that the errata are complete for all printings, the answer pages should *not* be changed throughout to conform to the errata slip.

<i>Page</i>	<i>Answer for</i>	<i>Should read</i>
2.	Problem 34, page 13.	\$495.
3.	Problem 40, page 14.	2 $\frac{1}{4}$ T.
7.	Problem 6, page 60.	$\frac{3}{8}$ ft.
9.	Problem 22, page 74.	8 $\frac{3}{8}$ ft.
	Problem 40, page 75.	123 $\frac{1}{16}$ gr.
10.	Problem 27, page 80.	120 mi.
	Problem 22, page 83.	55 $\frac{1}{4}$ sq. in.
	Problem 18, page 84.	\$145.97.
	Problem 3, page 85.	304 $\frac{1}{2}$ ft.
	Problem 12, page 85.	129 $\frac{1}{2}$ ft.
11.	Problem 4, page 90.	$\frac{3}{8}$ ft.
	Problem 7, page 90.	3 $\frac{3}{8}$ ft.
	Problem 12, page 90.	$\frac{1}{2}$ ft.
12.	Problem 100, page 98.	38 yd.
13.	Problem 12, page 104.	6.278 mi.
14.	Problem 3 (4th part), page 118.	.008 $\frac{1}{7}$.
16.	Problem 3, page 133.	548 gal.
	Problem 13, page 137.	\$416.67.
	Problem 5 (2d part), page 138.	78 sq. yd.
17.	Problem 7, page 143.	\$9.00 for side walls; \$12.60, cost, including ceiling paper.

<i>Page</i>	<i>Answer for</i>	<i>Should read</i>
17.	Problem 9, page 143.	\$35.88.
	Problem 5, page 147.	\$8.62.
	Problem 6, page 149.	354 $\frac{1}{2}$ cu. ft.
18.	Problem 17, page 152.	17 $\frac{1}{2}$ yd., or 8 strips, each 20 ft. long.
	Problem 24 (1st part), page 152.	567 cu. ft. oxygen.
	Problem 26, page 153.	18 hr.
	Problem 29, page 153.	1,542.8 + bu.
19.	Problem 3, page 166.	4.3.
	Problem 8, page 168.	490.275 mi.
20.	Problem 29, page 177.	55.4 mi.
21.	Problem 49 (2d part), page 188.	82 $\frac{1}{2}$ %.
22.	Problem 5, page 195.	\$3,120.
23.	Problem 9 (4th part), page 199.	\$24.
	Problem 3, page 199.	\$379.
	Problem 24, page 202.	\$31.69.
	Problem 4, page 204.	\$501.58.
	Problem 5, page 205.	\$120.
24.	Problem 7, page 206.	\$1.20.
	Problem 9 (2d part), page 207.	19. + %.
	Problem 10, page 213.	\$158.57.
25.	Problem 162, page 218.	163 gal. 1 pt.
26.	Problem 176, page 218.	One.
27.	Problem 65, page 224.	1,920 bricks; \$12.96.
	Problem 66 (2d part), page 224.	63,860 in.
	Problem 73, page 225.	\$111, including ceilings.
	Problem 94, page 227.	12,000 lb.; 6 T.
	Problem 95, page 227.	918. + mi.
	Problem 97, page 227.	21,120 ft.
	Problem 99, page 227.	\$124.74.
	Problem 123, page 230.	Deduct 35 ¢.

ANSWERS TO THE APPLETON ARITHMETICS

SECOND BOOK

Page 2

- | | | |
|---------------|----------------|---------------|
| 1. 285,125. | 8. M. | 15. MCMX. |
| 2. 520,075. | 9. MCMVIII. | 16. XXV. |
| 3. 801,502. | 10. XLIII. | 17. C. |
| 4. 3,500,009. | 11. D. | 18. MDCXX. |
| 5. 628.35. | 12. MDCCLXXVI. | 19. MDCCCLIV. |
| 6. 2,400.24. | 13. XVII. | 20. MCCLXV. |
| 7. LXXVI. | 14. CXXV. | 21. MCDXCH. |

Page 4

- | | | | |
|------------|-------------|--------------|------------------|
| 1. 3. | 7. 23,577. | 12. 4,970. | 17. 161,893. |
| 3. 225. | 8. 38,400. | 13. 17,700. | 18. \$322. |
| 4. 168 hr. | 9. 1,845. | 14. 72,611. | 19. \$506.97. |
| 5. 364 da. | 10. 27,735. | 15. 40,710. | 20. \$22,112.24. |
| 6. 1,088. | 11. 21,900. | 16. 174,794. | |

Page 6

- | | | | |
|-----------------------|------------------------|------------------------|------------|
| 1. 81. | 8. \$9.14. | 15. $70\frac{3}{25}$. | 22. 2,457. |
| 2. 110. | 9. $21\frac{2}{7}$. | 16. 56. | 23. 144. |
| 3. \$6.90. | 10. $135\frac{1}{2}$. | 17. 150. | 24. 812. |
| 4. $20\frac{1}{3}$. | 11. 69. | 18. \$1.50. | 25. 151. |
| 5. $35\frac{4}{11}$. | 12. 401. | 19. $201\frac{2}{3}$. | 26. 200. |
| 6. 91. | 13. \$6.01. | 20. $200\frac{1}{2}$. | 27. 1,331. |
| 7. 11. | 14. $22\frac{1}{11}$. | 21. 71. | 28. 2,814. |

Page 7

- | | | | | |
|----------------------|-----------------------------|-----------------------|----------------------|-----------------------|
| 1. $1\frac{1}{12}$. | 10. $\frac{7}{30}$. | 19. $\frac{11}{10}$. | 28. $2\frac{1}{2}$. | 36. $\frac{1}{2}$. |
| 2. $1\frac{1}{2}$. | 11. $\frac{11}{12}$. | 20. $\frac{1}{2}$. | 29. $1\frac{1}{2}$. | 37. $\frac{2}{3}$. |
| 3. $1\frac{7}{15}$. | 12. $\frac{1}{12}$. | 21. $\frac{2}{3}$. | 30. $6\frac{1}{2}$. | 38. $\frac{3}{10}$. |
| 4. $1\frac{5}{12}$. | 13. $\frac{3}{10}$. | 22. 2. | 31. 4. | 39. $\frac{5}{12}$. |
| 5. $\frac{9}{10}$. | 14. $\frac{1}{2}$. | 23. $6\frac{1}{2}$. | 32. $2\frac{1}{2}$. | 40. $\frac{2}{3}$. |
| 6. $1\frac{1}{2}$. | 15. $\frac{1}{15}$. | 24. $1\frac{1}{2}$. | 33. $4\frac{1}{2}$. | 41. $\frac{1}{2}$. |
| 7. $1\frac{7}{12}$. | 16. $\frac{3}{10}$. | 25. $5\frac{1}{2}$. | 34. 8 hr. | 42. $1\frac{2}{5}$. |
| 8. $1\frac{1}{2}$. | 17. $\frac{2}{3}$ of a day. | 26. $1\frac{1}{2}$. | 35. 20. | 43. $1\frac{2}{11}$. |
| 9. $\frac{1}{2}$. | 18. $1\frac{7}{24}$ hr. | 27. $7\frac{1}{2}$. | | |

Page 8

- | | | | | |
|---------------------------------------|-------------|------------|---------------|-------------|
| 44. 15.97. | 47. 131.60. | 50. 127.4. | 53. 42.84. | 56. .15. |
| 45. 588.5 | 48. 34.1. | 51. 1.25. | 54. 439.68. | 57. .20. |
| 46. 160.19. | 49. 30.85. | 52. 162. | 55. 625.67. | 58. 4.1. |
| 59. 9.51. | | | 61. 215.4 mi. | 63. 57.2 yd |
| 60. .5; .25; .5; .75; .2; .6; .8; .4. | | | 62. 10.5 A. | |

Page 9

- | | | |
|--------------------|--------------------|------------------|
| 9. 19 ft. 8 in. | 12. 38 min. 8 sec. | 15. 23 lb. 2 oz. |
| 10. 13 rd. 8.5 ft. | 13. 16 bu. 2 pk. | 16. 2 gal. 3 qt. |
| 11. 12 gal. 1 qt. | 14. 50 wk. 4 da. | 17. 24 wk. 4 da. |

Page 10

- | | |
|---|--|
| 2. \$2.25; \$3.75; \$1.28; \$10.80; total, \$18.08. | |
| 3. 4 yd. | 4. $\frac{1}{2}$; $\frac{1}{2}$; $\frac{1}{3}$; $\frac{2}{3}$; $\frac{1}{4}$. |
| 1. 10 bales; 100 bales. | 2. 50,000; \$50. |
| | 3. \$1,875. |
| | 5. \$12.75. |

Page 11

- | | | | |
|-------------------------------------|---|---------------|------------|
| 4. \$70. | 5. \$100. | 6. \$150. | 8. 140 yd. |
| 9. 10 ft.; 20 ft.; 120 ft.; 140 ft. | 10. $\frac{1}{2}$ in.; $\frac{1}{4}$ in.; $\frac{3}{4}$ in.; $1\frac{1}{2}$ in.; $1\frac{7}{8}$ in. | | |
| 11. 168 hr. | 14. $\frac{7}{4}$ of a year. | 17. 48. | |
| 12. 480 min. | 15. \$2.40. | 18. 140. | |
| 13. 240 sec.; $\frac{1}{15}$ hr. | 16. \$11.25. | 19. \$38,400. | |

Page 12

- | | | |
|-----------------------------|---------------------------|-------------------|
| 20. 40 ft.; 75 ft.; 230 ft. | 21. 30 ft.; 65 ft.; 5 ft. | 22. 3,000 sq. ft. |
| 27. \$2.34. | 28. \$1.52. | |

Page 13

- | | | | |
|---------------|------------|--------------|---------------|
| 29. 25 lb. | 31. 1,600. | 33. \$19.65. | 35. \$288. |
| 30. 200; 800. | 32. \$64. | 34. \$495. | 38. \$604.92. |

Page 26

1. 11,610. 2. 22,127. 3. 43,152. 4. 4,350. 5. 47,775.

Page 27

6. 213,161. 9. 4,732,910. 12. 447,692. 14. 5,535 T. 16. 4,290 mi.
 7. 1,080,864. 10. 963,248. 13. 3,589,821. 15. 26,875 yd. 17. 661,920 lb.
 8. 3,005,415. 11. 432,208.

Page 28

1. 340; 300; 180; 240; 960. 5. 340 T.; 500 T.; 260 T.; 560 T.
 2. 600; 680; 800; 3,440; 2,160. 6. 760 bu.; 960 bu.; 1,320 bu.; 2,600 bu.
 3. 900; 1,500; 1,700; 4,800; 12,500. 7. 2,700 ft.; 4,500 ft.; 8,700 ft.
 4. 7,500; 4,500; 2,700; 6,000; 12,000.

Page 29

1. \$70,665. 4. 24,000 min. 7. 378,840 lb. 10. 61,908 yd.
 2. 36,846 gal. 5. \$175,200. 8. 626,200 lb. 11. 777,777 hr.
 3. 311,304 qt. 6. 17,280 in. 9. 187,200 ft. 12. 264,600 T.
 1. \$74.40. 4. \$366.25. 7. \$4,136.48. 10. \$16.66. 13. \$631.80.
 2. \$450. 5. \$755.37. 8. \$271.13. 11. \$9.60. 14. \$940.80.
 3. \$611.80. 6. \$671.40. 9. \$6,990.50. 12. \$172.22. 15. \$4,410.

Page 31

1. 7². 2. 12². 3. 3². 4. 12². 5. 10².
 1. 10,350 sq. ft. 3. \$1,750. 5. \$350. 7. 4,200.
 2. 113,400 cu. ft. 4. \$840. 6. \$1,837.50. 8. \$4,200.

Page 32

4. 23. 8. 81. 11. 91. 14. 10. 17. 61.
 5. 43. 9. 61. 12. 81. 15. 81. 18. 50.
 6. 42. 10. 71. 13. 202. 16. 101. 19. 20.
 7. 41.

Page 33

1. 39. 3. 41 $\frac{1}{2}$. 5. 89. 7. 92. 9. 322.
 2. 72. 4. 16. 6. 64. 8. 136 $\frac{2}{3}$ 10. 508.
 11. \$18; \$72. 14. 12 wk.
 12. 86 ft.; 60 mi. 15. 150.
 13. 9 sq. in.; 144 cu. in. 16. 72 rows, 2 plants.

Page 34

2. $12\frac{1}{2}$ yd.
3. $10\frac{1}{2}$ bu.

4. $31\frac{1}{4}$ gal.
5. $52\frac{1}{7}$ wk.

6. $21\frac{1}{2}$ ft.
7. 20 lb.

Page 37

1. $4\frac{2}{3}$; $12\frac{9}{10}$; $38\frac{1}{2}$; $62\frac{1}{10}$; $128\frac{2}{3}$; $195\frac{1}{2}$. 3. \$65 $\frac{1}{2}$.
2. $29\frac{9}{25}$; $9\frac{9}{20}$; $1\frac{2}{3}$; $6\frac{1}{4}$; $10\frac{3}{50}$; $46\frac{1}{100}$.

Page 38

- | | | | | |
|---------------------------------|----------------------------------|-------------------------------------|----------------------|-----------------------------|
| 1. 38. | 6. $40\frac{1}{3}\frac{1}{3}$. | 11. $2240\frac{7}{137}$. | 16. 128. | 21. 189,900 mi. |
| 2. 65. | 7. 300. | 12. $2235\frac{3}{55}\frac{2}{5}$. | 17. 192 A.. | 22. $1,041\frac{2}{3}$ mi.; |
| 3. $68\frac{1}{9}\frac{6}{9}$. | 8. $173\frac{1}{4}$. | 13. $981\frac{3}{10}\frac{1}{10}$. | 18. \$2,405. | $17\frac{1}{3}$ mi. |
| 4. $626\frac{5}{6}$. | 9. $209\frac{2}{3}\frac{1}{3}$. | 14. $2209\frac{1}{10}\frac{3}{4}$. | 19. $\frac{4}{30}$. | 23. 139 gro. T. |
| 5. 377. | 10. 729. | 15. $1013\frac{2}{3}\frac{7}{8}$. | 20. 3,982. | 24. 110 mi. |

Page 39

- | | | | |
|----------------------------|-------------|--------------|---------------|
| 1. \$15.04. | 5. \$3.77. | 9. \$8.14. | 13. \$55.75. |
| 2. \$6.25. | 6. \$13.52. | 10. \$30.11. | 14. \$126.50. |
| 3. \$3.50 $\frac{1}{8}$. | 7. \$13.05. | 11. \$27.01. | 15. \$43.27. |
| 4. \$7.18 $\frac{3}{23}$. | 8. \$.38. | 12. \$3.10. | 16. \$1.40. |

Page 41

- | | | | |
|-----------|--------------|--------------|--------------|
| 1. \$31. | 3. \$342.78. | 5. \$345.70. | 7. \$548.15. |
| 2. \$108. | 4. \$37.50. | 6. \$91.34. | |

Page 42

1. 18¢; \$43.93.

Page 43

- | | | |
|--------------------------------|----------------------|----------|
| 2. 3¢; 3¢; 5¢.
5¢; 8¢; 10¢. | 5. 10¢. | 9. 12¢. |
| 3. \$60.15; \$60.40. | 6. 10¢. | 10. 12¢. |
| 4. \$83.55. | 7. \$53.35; \$53.55. | 11. 10¢. |
| | 8. \$1.50. | 12. 8¢. |

Page 45

- | | | | | |
|-------------|-------------|--------------|-------------|--------------|
| 1. \$6.15. | 4. \$3.10. | 7. \$4.80. | 10. \$6.90. | 13. \$1.90. |
| 2. \$3.95. | 5. \$12.95. | 8. \$11.95. | 11. \$4.15. | 14. \$12.10. |
| 3. \$11.75. | 6. \$20.35. | 9. \$3.30. | 12. \$17. | 15. \$7.45. |
| | | 16. \$10.55. | | |

Page 46

- | | | |
|--|------------------|----------------|
| 1. 2¢; 6¢; 10¢; 4¢; 4¢; 6¢; 14¢. | | |
| 2. \$42.10. | 3. 2¢. | 4. \$1,035.16. |
| 6. 3 oz., or less than 3 oz., and over 2 oz. | | 5. 12 oz. |
| 7. 36¢. | 8. \$2.88; \$10. | 9. \$25. |

Page 48

- | | | |
|-------------------------|----------------------|---------------------------|
| 1. 2, 3, 5, 7. | 6. 5, 5, 5, 13. | 11. 2, 2, 2, 5, 5, 5. |
| 2. 2, 2, 2, 2, 2, 5, 7. | 7. 3, 3, 3, 5, 11. | 12. 3, 7, 101. |
| 3. 3,809. | 8. 3, 3, 3, 3, 3, 5. | 13. 2, 3, 197. |
| 4. 2, 5, 7, 7, 11. | 9. 5, 5, 5, 5. | 14. 2, 2, 2, 2, 5, 7, 11. |
| 5. 2, 2, 2, 2, 3, 3. | 10. 2, 3, 3, 11, 11. | 15. 2, 5, 5, 5, 5, 5. |

Page 50

- | | | |
|-----------------------|--------------|---|
| 7. 3, or 9. | 10. 11. | 13. 5. |
| 8. 3, 5, or 15. | 11. 2, 4, 8. | 14. 13. |
| 9. 2, 3, 4, 6, or 12. | 12. 7. | 15. $\frac{2}{3}$; $\frac{4}{3}$; $\frac{8}{3}$; $\frac{5}{10}$; $\frac{1}{100}$; $\frac{25}{100}$. |
| 1. 9. | 4. 64. | 7. 25. |
| 2. 11. | 5. 5. | 8. 7. |
| 3. 6. | 6. 12. | 9. 144. |

Page 51

- | | | | |
|---------|------------|---------|----------|
| 10. 6. | 12. 11. | 14. 21. | 16. 250. |
| 11. 28. | 13. 1,024. | 15. 6. | 17. 8. |

Page 52

- | | | | |
|---------|---------|---------|-------------|
| 1. 252. | 4. 252. | 7. 108. | 10. 180. |
| 2. 216. | 5. 28. | 8. 300. | 11. \$1.50. |
| 3. 154. | 6. 352. | 9. 288. | |

Page 53

- | | | | |
|--------------------|---------|---------|------------|
| 1. 240. | 3. 594. | 5. 180. | 7. 150. |
| 2. 150. | 4. 192. | 6. 441. | 8. 847. |
| 1. $\frac{7}{8}$. | 2. 30. | 3. 21. | 4. 13,500. |

Page 55

1. 3,270,065. 2. 25,090,120. 3. 87,087,449. 4. 20,040,140.
 5. XIX; XXVI; XXXV; XXXIX; XLIII; LVI; XLIX; C; XCVII;
 LXIII; XLV; XC; LXXXV.
 6. 0, 1, 4, 9, 16, 25, 36, 49, 64, 81.
 7. 12; 16. 9. $\frac{77}{3240}$. 11. \$2,531.40. 13. \$27,673.
 8. 1,694; 175,812. 10. $2\frac{1}{2}$. 12. \$322. 14. 42.

Page 56

15. \$20. 16. \$125. 17. 708 lb.
 18. Neck, \$0.72; chuck, \$7.80; prime of rib, \$9.52; porterhouse, \$18.40;
 sirloin, \$5.44; rump, \$1.96; round, \$14.88; plate, \$4.48; flank, \$8.8;
 shin, \$2.00; shank, \$.60; total, \$66.68.
 19. Chuck; flank; porterhouse; porterhouse.
 20. 74.3 lb.; \$5.48. 21. Leg; rib; leg; leg.

Page 57

22. Rose, 20,196.40 lb.; Nora, 19,598.90 lb.
 23. 3,569.60 lb.; 266.18 lb.
 24. Rose, 4,925.65+ qt.; Nora, 3,373.65+ qt.
 25. Rose, \$246.28; Nora, \$168.68. Rose, \$90.37; Nora, \$47.78.
 26. 6 lb.; \$1.20. 27. 75 lb. 28. $37\frac{1}{2}$ lb.; \$12.

Page 58

29. \$36,964,663.50. 32. \$62.50. 35. 385. 38. 97,000.
 30. \$300,000. 33. \$1,636. 36. 45,600. 39. 7,720.
 31. 50,000 34. \$15,000,000. 37. 148,750.

Page 60

1. $\frac{25}{33}$. 2. $\frac{17}{85}$. 3. $\frac{10}{101}$. 4. $\frac{300}{1000}$. 5. $\frac{5}{300}$. 6. $\frac{301}{301}$. 7. $\frac{205}{3510}$. 8. $59\frac{13}{31}$.

Page 62

1. $\frac{13}{5}$. 6. $\frac{34}{5}$. 11. $\frac{21}{16}$. 16. $\frac{23}{8}$. 21. $\frac{17}{2}$. 26. $\frac{42}{5}$.
 2. $\frac{29}{2}$. 7. $\frac{5}{2}$. 12. $\frac{13}{8}$. 17. $\frac{49}{8}$. 22. $\frac{51}{4}$. 27. $\frac{59}{8}$.
 3. $\frac{8}{3}$. 8. $\frac{29}{3}$. 13. $\frac{10}{3}$. 18. $\frac{73}{10}$. 23. $\frac{82}{5}$. 28. $\frac{25}{4}$.
 4. $\frac{13}{12}$. 9. $2\frac{9}{12}$. 14. $\frac{58}{9}$. 19. $\frac{5}{2}$. 24. $\frac{52}{3}$. 29. $\frac{35}{12}$.
 5. $\frac{23}{3}$. 10. $\frac{27}{16}$. 15. $\frac{25}{3}$. 20. $\frac{3}{2}$. 25. $\frac{43}{8}$. 30. $\frac{81}{2}$.

Page 63

1. $\frac{2}{12}$, $\frac{3}{8}$, $\frac{4}{6}$, $\frac{5}{4}$, $\frac{6}{3}$. 3. .7, $\frac{7}{8}$, $\frac{7}{5}$, $\frac{7}{3}$, $\frac{7}{2}$. 5. $\frac{2}{3}$, $\frac{5}{8}$, $\frac{7}{4}$, $\frac{8}{3}$, $\frac{11}{2}$.
 2. $\frac{13}{18}$, $\frac{11}{12}$, $\frac{10}{16}$, $\frac{10}{4}$, $\frac{10}{2}$. 4. $\frac{2}{10}$, $\frac{2}{16}$, .0, $\frac{2}{8}$, $\frac{2}{4}$.
 6. England, Denmark, Germany, Venezuela.
 7. Connecticut, Georgia, New Hampshire, Pennsylvania, Rhode Island, North Carolina, South Carolina, Massachusetts.

Page 64

8. New Hampshire, New York, Massachusetts.

Page 66

1. $\frac{2}{3}$. 6. $\frac{1}{12}$. 11. $\frac{1}{12}$. 16. $\frac{1}{3}$. 21. $\frac{1}{6}$. 26. $\frac{1}{3}$. 31. $\frac{1}{18}$.
 2. $\frac{2}{17}$. 7. $\frac{1}{3}$. 12. $\frac{1}{3}$. 17. $\frac{1}{10}$. 22. $\frac{2}{3}$. 27. $\frac{1}{3}$. 32. $\frac{1}{3}$.
 3. $\frac{1}{18}$. 8. $\frac{1}{3}$. 13. $\frac{1}{4}$. 18. $\frac{1}{3}$. 23. $\frac{1}{3}$. 28. $\frac{1}{3}$. 33. $\frac{1}{3}$.
 4. $\frac{1}{18}$. 9. $\frac{1}{3}$. 14. $\frac{1}{3}$. 19. $\frac{1}{3}$. 24. $\frac{1}{3}$. 29. $\frac{1}{3}$. 34. $\frac{1}{11}$.
 5. $\frac{1}{12}$. 10. $\frac{1}{3}$. 15. $\frac{2}{3}$. 20. $\frac{1}{3}$. 25. $\frac{1}{3}$. 30. $\frac{1}{3}$. 35. $\frac{1}{3}$.

Page 68

1. $\frac{20}{24}$, $\frac{4}{6}$. 3. $\frac{18}{24}$, $\frac{3}{4}$, $\frac{7}{8}$. 5. $\frac{18}{24}$, $\frac{3}{4}$, $\frac{3}{4}$. 7. 2, 3, 5.
 2. $\frac{12}{24}$, $\frac{2}{3}$, $\frac{10}{24}$. 4. $\frac{1}{16}$, $\frac{1}{16}$, $\frac{1}{16}$. 6. $\frac{1}{16}$, $\frac{1}{16}$, $\frac{1}{16}$. 8. 32, 42, 28, 8, 18, 20.

Page 70

1. $1\frac{1}{2}$. 2. $\frac{7}{8}$. 3. $1\frac{1}{2}$. 4. $1\frac{1}{2}$. 5. $\frac{3}{4}$. 6. $1\frac{1}{2}$. 7. $1\frac{1}{2}$. 8. $1\frac{1}{2}$.
 9. $1\frac{1}{2}$. 10. $\frac{3}{4}$. 11. $1\frac{1}{2}$. 12. $1\frac{1}{2}$. 13. $1\frac{1}{2}$. 14. $1\frac{1}{2}$. 15. $1\frac{1}{2}$.
 16. $1\frac{1}{2}$. 17. $1\frac{1}{2}$. 18. $1\frac{1}{2}$. 19. $2\frac{1}{2}$. 20. $2\frac{1}{2}$. 21. $1\frac{1}{2}$. 22. $2\frac{1}{2}$.
 23. $2\frac{1}{2}$. 24. $1\frac{1}{2}$. 25. $2\frac{1}{2}$. 26. $1\frac{1}{2}$. 27. $2\frac{1}{2}$. 28. $1\frac{1}{2}$. 29. $\frac{1}{2}$.

Page 71

30. $1\frac{1}{2}$ mi. 31. $1\frac{1}{2}$ ft. 32. $\frac{1}{2}$ yd. 33. $\frac{1}{2}$. 34. $\frac{1}{2}$. 35. $\frac{1}{2}$. 36. $\frac{1}{2}$.

Page 72

1. $4\frac{1}{2}$. 5. $\frac{5}{16}$. 9. $\frac{1}{2}$. 13. $\frac{1}{2}$. 17. $\frac{5}{16}$. 21. $\frac{1}{2}$. 25. $\frac{1}{2}$. 29. $\frac{5}{16}$ gal.
 2. $1\frac{1}{2}$. 6. $\frac{1}{4}$. 10. $\frac{1}{2}$. 14. $\frac{1}{2}$. 18. $\frac{1}{2}$. 22. $\frac{1}{2}$. 26. $\frac{1}{2}$. 30. $\frac{1}{2}$.
 3. $\frac{1}{2}$. 7. $\frac{1}{2}$. 11. $\frac{1}{2}$. 15. $\frac{1}{2}$. 19. $\frac{1}{2}$. 23. $\frac{1}{2}$. 27. $\frac{1}{2}$. 31. $\frac{1}{2}$.
 4. $\frac{1}{2}$. 8. $\frac{1}{2}$. 12. $\frac{1}{2}$. 16. $\frac{1}{2}$. 20. $\frac{1}{2}$. 24. $\frac{1}{2}$. 28. $\frac{1}{2}$ yd.

Page 73

32. $\frac{1}{2}$ yd. 33. $\frac{1}{2}$. 34. $\frac{1}{2}$; $\frac{1}{2}$. 35. Frank, $\frac{1}{2}$ more. 36. Roy, $\frac{1}{2}$ bu. more.

Page 74

- | | | | | | | |
|------------------------|-----------------------|--|------------------------|---|------------------------|------------------------|
| 1. $4\frac{1}{2}$. | 6. $2\frac{4}{11}$. | 11. $68\frac{1}{2}$. | 16. $11\frac{1}{4}$. | 21. $7\frac{7}{12}$. | 26. $113\frac{1}{3}$. | 31. $15\frac{1}{2}$. |
| 2. $2\frac{1}{4}$. | 7. $1\frac{1}{15}$. | 12. $13\frac{1}{3}$. | 17. $134\frac{3}{8}$. | 22. $8\frac{3}{8}$. | 27. $34\frac{1}{4}$. | 32. $20\frac{1}{11}$. |
| 3. $1\frac{1}{3}$. | 8. $2\frac{1}{3}$. | 13. $2\frac{3}{8}$. | 18. $7\frac{1}{4}$. | 23. $10\frac{1}{3}$. | 28. $8\frac{1}{6}$. | 33. $44\frac{7}{8}$. |
| 4. 1. | 9. $9\frac{5}{12}$. | 14. $84\frac{3}{10}$. | 19. $9\frac{1}{6}$. | 24. $10\frac{1}{4}$. | 29. $42\frac{1}{10}$. | 34. $18\frac{2}{3}$. |
| 5. 2. | 10. $6\frac{1}{10}$. | 15. $6\frac{1}{2}$. | 20. $88\frac{4}{10}$. | 25. $28\frac{1}{12}$. | 30. $8\frac{1}{4}$. | 35. $16\frac{2}{7}$. |
| 36. $21\frac{1}{12}$. | | 37. $17\frac{1}{4}$ mi. ; $7\frac{1}{4}$ mi. | | 38. $2\frac{1}{2}$ yr. ; $20\frac{7}{12}$ yr. ; $32\frac{1}{2}$ yr. | | |

Page 75

- | | | | | | |
|-------------------------|---------------------------|-----------------------|-----------------------|------------------------|-----------------------|
| 39. $25\frac{1}{2}$ gr. | 40. $123\frac{1}{10}$ gr. | | | | |
| 1. $8\frac{1}{2}$. | 6. $12\frac{1}{3}$. | 11. 13. | 16. $15\frac{3}{8}$. | 21. $25\frac{1}{3}$. | 26. $62\frac{1}{2}$. |
| 2. $9\frac{5}{8}$. | 7. $1\frac{1}{2}$. | 12. $10\frac{1}{3}$. | 17. $23\frac{1}{2}$. | 22. $31\frac{1}{15}$. | 27. $73\frac{1}{4}$. |
| 3. $3\frac{1}{5}$. | 8. $2\frac{5}{12}$. | 13. $1\frac{1}{4}$. | 18. $26\frac{5}{8}$. | 23. $6\frac{1}{11}$. | |
| 4. $3\frac{1}{12}$. | 9. $3\frac{1}{10}$. | 14. $\frac{1}{2}$. | 19. $7\frac{1}{2}$. | 24. $34\frac{3}{4}$. | |
| 5. $3\frac{1}{4}$. | 10. $1\frac{7}{12}$. | 15. $5\frac{1}{10}$. | 20. $17\frac{3}{8}$. | 25. $44\frac{7}{8}$. | |

Page 76

- | | |
|---|--|
| 28. $4\frac{7}{8}$ yd. | 34. $89\frac{1}{4}$ A. |
| 29. Charles, $\frac{3}{4}$ mi. farther. | 35. $2\frac{1}{4}$ mi. |
| 30. $9\frac{1}{8}$ lb. | 36. $1\frac{1}{8}$ hr. |
| 31. $1\frac{3}{4}$ yd. | 37. $112\frac{7}{8}$ A., $139\frac{3}{16}$ A., $354\frac{1}{8}$ A. |
| 32. $25\frac{1}{16}$ lb. | 38. $92\frac{5}{8}$ yd. |
| 33. $2\frac{3}{4}$ gal. | 39. $2\frac{5}{8}$ mi. |

Page 78

- | | | | |
|-----------------------|-----------------------|-------------------------|---------------|
| 1. 45. | 10. $5\frac{7}{8}$. | 19. $22\frac{1}{2}$. | 28. \$ 1.10. |
| 2. $2\frac{1}{4}$. | 11. $5\frac{1}{8}$. | 20. 51. | 29. \$ 15.12. |
| 3. $14\frac{7}{12}$. | 12. $9\frac{1}{3}$. | 21. 6 yd. | 30. \$ 3. |
| 4. 252. | 13. 91. | 22. $53\frac{3}{4}$ ft. | 31. \$ 70.83. |
| 5. $2\frac{3}{4}$. | 14. 48. | 23. 5 hr. | 32. \$ 37.33. |
| 6. $11\frac{1}{2}$. | 15. $\frac{3}{2}$. | 24. \$ 15. | 33. \$ 1.54. |
| 7. $9\frac{1}{2}$. | 16. 102. | 25. \$ 15.53. | 34. \$ 50.70. |
| 8. 50. | 17. $24\frac{1}{2}$. | 26. \$ 121.88. | |
| 9. $11\frac{1}{2}$. | 18. 110. | 27. \$ 2.50. | |

Page 79

- | | | | | | |
|------------------------|------------------------|-------------------------|-------------------------|-------------------------|--------------------------|
| 1. 350. | 5. 220. | 9. 180. | 13. 588 $\frac{1}{2}$. | 17. 720. | 21. 266 $\frac{2}{3}$. |
| 2. 24 $\frac{1}{2}$. | 6. 8. | 10. 122 $\frac{1}{2}$. | 14. $\frac{1}{2}$. | 18. 168. | 22. 720. |
| 3. 156 $\frac{3}{4}$. | 7. 268 $\frac{1}{2}$. | 11. 14 $\frac{1}{2}$. | 15. 153. | 19. 288. | 23. 100 $\frac{5}{21}$. |
| 4. 116 $\frac{1}{2}$. | 8. 106 $\frac{1}{2}$. | 12. 33. | 16. 675. | 20. 128 $\frac{1}{2}$. | 24. 80. |

Page 80

- | | | |
|---|-------------|-------------|
| 25. 100 mi. ; 50 mi. ; 25 mi. ; 12 $\frac{1}{2}$ mi. ; 10 mi. | 29. 60 mi. | 31. 140 mi. |
| 26. 260 mi. | 27. 120 mi. | 28. 75 mi. |
| | 30. 140 mi. | 32. 140 mi. |

Page 81

- | | | | | | | | | |
|--------------------|---------------------|---------------------|---------------------|----------------------|---------------------|---------------------|----------------------|----------------------|
| 7. $\frac{1}{2}$. | 8. $\frac{1}{25}$. | 9. $\frac{7}{15}$. | 10. $\frac{1}{2}$. | 11. $\frac{1}{25}$. | 12. $\frac{1}{2}$. | 13. $\frac{1}{2}$. | 14. $\frac{25}{2}$. | 15. $\frac{1}{21}$. |
|--------------------|---------------------|---------------------|---------------------|----------------------|---------------------|---------------------|----------------------|----------------------|

Page 82

- | | | | | | | |
|--------------------|---------------------|-----------------------|----------------------|------------------------|----------------------------|-----------------------|
| 1. $\frac{1}{2}$. | 3. 6. | 5. 23 $\frac{1}{2}$. | 7. $\frac{1}{25}$. | 9. 141 $\frac{1}{2}$. | 11. $\frac{1}{25}$ sq. in. | 16. $\frac{2}{3}$ mi. |
| 2. $\frac{3}{8}$. | 4. $\frac{1}{11}$. | 6. $\frac{2}{10}$. | 8. 1 $\frac{1}{2}$. | 10. $\frac{2}{3}$ qt. | 12. $\frac{1}{25}$ sq. in. | |

Page 83

- | | | | | | |
|---------------------|-----------------------|------------------------------|-------------------------------|------------------------------|-------------------------------|
| 17. $\frac{1}{2}$. | 18. 1 $\frac{1}{3}$. | 19. 8 $\frac{1}{10}$ sq. in. | 20. 15 $\frac{1}{25}$ sq. ft. | 21. 1 $\frac{1}{11}$ sq. in. | 22. 808 $\frac{1}{3}$ sq. in. |
|---------------------|-----------------------|------------------------------|-------------------------------|------------------------------|-------------------------------|

Page 84

- | | | | |
|-----------|-------------------------|---------------|-----------------------------|
| 1. 2,303. | 7. 2,700. | 13. 5,640. | 19. \$3.78. |
| 2. 1,030. | 8. 892 $\frac{1}{2}$. | 14. 600. | 20. 67 $\frac{1}{2}$ yd. |
| 3. 1,624. | 9. 1,300. | 15. 1,368. | 21. \$21.87 $\frac{1}{2}$. |
| 4. 140. | 10. 392 $\frac{1}{2}$. | 16. 1,179. | 22. 668 $\frac{1}{2}$ mi. |
| 5. 1,469. | 11. 1,214. | 17. \$3.40. | 23. 115 $\frac{1}{2}$ rd. |
| 6. 616. | 12. 1,076. | 18. \$145.97. | 24. 55 $\frac{1}{2}$ mi. |
25. \$33.33 ; \$5.63 ; total cost, \$38.96.

Page 85

- | | | | |
|-------------------------|---------------------------|-----------------------------|-------------------------------|
| 1. 211 $\frac{7}{10}$. | 9. 316 $\frac{1}{2}$. | 17. 1,926 $\frac{21}{20}$. | 25. 828 $\frac{1}{2}$. |
| 2. 33 $\frac{1}{2}$. | 10. 2,206 $\frac{2}{3}$. | 18. 1,282 $\frac{1}{10}$. | 26. 206 $\frac{2}{3}$. |
| 3. 304 $\frac{1}{2}$. | 11. 30 $\frac{1}{2}$. | 19. 86 $\frac{1}{2}$. | 27. 380 $\frac{1}{2}$. |
| 4. 116 $\frac{1}{2}$. | 12. 129 $\frac{1}{2}$. | 20. 1,229 $\frac{3}{10}$. | 28. 111 $\frac{1}{2}$ sq. yd. |
| 5. 308 $\frac{1}{2}$. | 13. 481 $\frac{1}{2}$. | 21. 15 $\frac{31}{10}$. | 29. 202 $\frac{1}{2}$ sq. ft. |
| 6. 349 $\frac{1}{2}$. | 14. 376 $\frac{1}{2}$. | 22. 1,759 $\frac{1}{2}$. | 30. 17 $\frac{5}{12}$ mi. |
| 7. 257 $\frac{1}{2}$. | 15. 338 $\frac{1}{2}$. | 23. 573 $\frac{1}{2}$. | 31. 64 $\frac{1}{2}$ A. |
| 8. 16 $\frac{1}{2}$. | 16. 225 $\frac{1}{2}$. | 24. 1,292 $\frac{1}{2}$. | |

Page 87

5. $1\frac{1}{2}$; $4\frac{1}{2}$; 3. 6. $1\frac{1}{2}$; $7\frac{1}{2}$; $3\frac{1}{2}$. 7. $2\frac{1}{2}$; 10; 5. 8. $1\frac{1}{2}$; $13\frac{1}{2}$; $6\frac{1}{2}$.

Page 88

1. $6\frac{1}{2}$. 4. $28\frac{1}{2}$. 7. 21. 10. $12\frac{1}{2}$. 13. $16\frac{1}{2}$. 16. 75. 19. 75.
 2. $19\frac{1}{2}$. 5. $15\frac{1}{2}$. 8. 200. 11. $8\frac{1}{2}$. 14. $13\frac{1}{2}$. 17. 16. 20. 15.
 3. $3\frac{1}{2}$. 6. $5\frac{1}{2}$. 9. 21. 12. 147. 15. $7\frac{1}{2}$. 18. 16. 21. $326\frac{1}{2}$.

Page 89

1. $\frac{5}{8}$. 3. $\frac{1}{4}$. 5. $\frac{20}{1}$. 7. $1\frac{1}{2}$. 9. $1\frac{1}{2}$. 11. $1\frac{1}{10}$. 13. $1\frac{1}{2}$. 15. $\frac{21}{4}$.
 2. $\frac{11}{22}$. 4. $\frac{26}{65}$. 6. $1\frac{1}{35}$. 8. $\frac{15}{128}$. 10. $\frac{9}{22}$. 12. $\frac{3}{4}$. 14. $\frac{5}{12}$. 16. $1\frac{7}{105}$.
 1. $\frac{4}{81}$. 3. $1\frac{1}{32}$. 5. $\frac{1}{40}$. 7. $\frac{1}{75}$. 9. $1\frac{1}{20}$. 11. $2\frac{1}{5}$.
 2. $\frac{1}{160}$. 4. $\frac{1}{48}$. 6. $\frac{1}{560}$. 8. $\frac{1}{50}$. 10. $\frac{1}{96}$. 12. $2\frac{1}{8}$.
 13. $1\frac{1}{40}$ min. 14. $\frac{8}{20}$ min. 15. $1\frac{1}{160}$ bbl. 16. $1\frac{1}{12}$ mi.

Page 90

1. $1\frac{1}{2}$. 3. $2\frac{1}{2}$. 5. $3\frac{1}{2}$. 7. $3\frac{1}{2}$. 9. $1\frac{1}{2}$. 11. $3\frac{1}{33}$. 13. 6.
 2. $6\frac{1}{2}$. 4. $2\frac{1}{2}$. 6. $\frac{7}{50}$. 8. $2\frac{1}{2}$. 10. $5\frac{1}{15}$. 12. $\frac{1}{33}$. 14. 2.
 15. 12; $1\frac{1}{2}$ in.; 6; 18; 3; 15. 16. 3. 17. 8.

Page 91

1. $\frac{1}{2}$. 3. $\frac{1}{9}$; $1\frac{3}{100}$; $\frac{1}{64}$. 5. $1\frac{9}{160}$. 7. $\frac{3}{64}$. 9. $\frac{5}{11}$.
 2. $\frac{3}{8}$; $\frac{3}{25}$; $\frac{1}{18}$. 4. $\frac{1}{15}$; $\frac{8}{80}$; $\frac{1}{61}$; $\frac{1}{7}$. 6. $\frac{9}{40}$. 8. $\frac{7}{13}$. 10. $\frac{4}{33}$.

Page 92

1. $562\frac{1}{2}$ A. 2. 1,760 yd. 3. 142 mi. 4. 540 bu. 5. \$15,216. 6. \$4,125.

Page 93

1. $\frac{9}{10}$. 2. 4. 3. $1\frac{1}{2}$. 4. $1\frac{1}{10}$. 5. $2\frac{1}{10}$. 6. $1\frac{744}{22275}$. 7. $678\frac{1}{3}$. 8. $4\frac{163}{1161}$.

Page 95

1. $\frac{3}{4}$. 8. $\frac{8}{10}$. 15. $\frac{3}{5}$. 21. $\frac{3}{4}$. 27. $1\frac{1}{2}$. 33. $\frac{95}{144}$. 39. $\frac{3}{8}$.
 2. $\frac{1}{2}$. 9. $\frac{3}{5}$. 16. $\frac{1}{4}$. 22. $\frac{1}{12}$. 28. $1\frac{1}{2}$. 34. $\frac{8}{50}$. 40. $1\frac{1}{2}$.
 3. $\frac{1}{3}$. 10. $\frac{4}{21}$. 17. $1\frac{1}{10}$. 23. $2\frac{7}{45}$. 29. $1\frac{47}{102}$. 35. $1\frac{103}{400}$. 41. $\frac{1}{2}$.
 4. $\frac{3}{4}$. 11. $\frac{23}{42}$. 18. $\frac{2}{11}$. 24. $1\frac{13}{48}$. 30. $1\frac{11}{12}$. 36. $\frac{147}{150}$. 42. 0.
 5. $\frac{1}{5}$. 12. $\frac{19}{42}$. 19. $\frac{2}{15}$. 25. $\frac{37}{51}$. 31. $1\frac{1}{2}$. 37. $1\frac{121}{300}$. 43. $53\frac{8}{20}$.
 6. $\frac{5}{9}$. 13. $\frac{1}{3}$. 20. $\frac{1}{3}$. 26. 161. 32. $100\frac{1}{3}$. 38. $176\frac{1}{10}$. 44. $10\frac{13}{32}$.
 7. $1\frac{8}{21}$. 14. $\frac{3}{8}$.

Page 96

45. $\frac{37}{100}$.	47. $43\frac{1}{2}$.	49. $\frac{11}{100}$.	51. $3\frac{1}{2}$.	53. $23\frac{1}{2}$.	55. 6.
46. $\frac{12}{100}$.	48. $1\frac{1}{2}$.	50. $\frac{28}{100}$.	52. 95.	54. $27\frac{1}{2}$.	56. 24.
57. $\frac{1}{2}$; $\frac{3}{8}$; $\frac{1}{2}$; $\frac{5}{8}$; $\frac{3}{4}$; $\frac{1}{4}$.				58. $\frac{2}{3}$; $\frac{2}{3}$; $\frac{7}{8}$; $\frac{5}{8}$; $\frac{3}{4}$; $\frac{1}{2}$.	
59. $\frac{1}{100}$.	63. $1\frac{5}{8}$.	67. $41\frac{3}{4}$.	71. 250.	75. $\frac{1}{2}$; $\frac{1}{3}$; $\frac{2}{3}$.	79. $\frac{10400}{100000}$.
60. $\frac{1}{50}$.	64. $\frac{3}{4}$.	68. $3\frac{1}{2}$.	72. $581\frac{1}{11}$.	76. $36\frac{1}{2}$.	80. 24 in.
61. $133\frac{1}{2}$.	65. $144\frac{5}{8}$.	69. $14\frac{1}{4}$.	73. $\frac{5}{8}$.	77. $113\frac{3}{4}$.	81. $6\frac{1}{2}$ in.
62. $112\frac{1}{2}$.	66. $1,012\frac{1}{2}$.	70. $14\frac{1}{4}$.	74. $\frac{1}{8}$; $\frac{1}{4}$; $\frac{1}{2}$.	78. $\frac{7}{10000}$.	

Page 97

82. 17 in.	84. $\frac{1}{2}$ in.	86. $9\frac{1}{2}$ yd.	88. $32\frac{5}{8}$ ft.
83. $8\frac{5}{8}$ in.	85. $4\frac{3}{8}$ in.	87. $431\frac{3}{4}$ yd.	89. $709\frac{1}{2}$ in.

Page 98

90. $144\frac{1}{2}$ ft.	93. $143\frac{5}{8}$ A.	96. 310 bu.	99. \$2,891.
91. $1\frac{3}{8}$ mi.	94. $5\frac{1}{2}$ ft.	97. $\frac{7}{8}$.	100. $20\frac{1}{2}$ yd.
92. $9\frac{7}{10}$ T.	95. $99\frac{1}{2}$ lb.	98. $193\frac{3}{10}$ mi.	101. \$123.75.

Page 100

1. .7.	9. .05.	17. 1.1.	25. .03.	49. $\frac{3}{100}$.	57. $\frac{103}{1000}$.	65. $\frac{29}{1000}$.
2. 19.9.	10. .99.	18. 4.5.	26. .25.	50. $\frac{1}{10}$.	58. $\frac{99}{1000}$.	66. $\frac{1}{100}$.
3. .11.	11. .40.	19. .1.	27. .55.	51. $\frac{15}{100}$.	59. $\frac{101}{1000}$.	67. $\frac{3}{10}$.
4. .35.	12. 5.05.	20. .6.	28. .10.	52. $\frac{9}{100}$.	60. $\frac{45}{1000}$.	68. $\frac{203}{1000}$.
5. 12.39.	13. .3.	21. .9.	29. .09.	53. $\frac{125}{1000}$.	61. $\frac{234}{1000}$.	69. $\frac{5}{1000}$.
6. 1.01.	14. .5.	22. .8.	30. .05.	54. $\frac{86}{1000}$.	62. $\frac{111}{1000}$.	70. $\frac{5625}{100000}$.
7. 20.2.	15. 1.4.	23. .7.	31. .15.	55. $\frac{71}{100}$.	63. $\frac{1003}{1000}$.	71. $\frac{75}{1000}$.
8. 22.2.	16. 3.9.	24. .4.	32. 1.75.	56. $\frac{1}{100}$.	64. $\frac{175}{1000}$.	72. $\frac{290}{1000}$.

Page 102

1. .017.	4. .009.	7. .095.	10. 1.3; 4; .3.
2. .843.	5. .085.	8. .105.	11. 10.5; .40.
3. .125.	6. .066.	9. .222.	
12. .30; .50; .70; .60; 8.00; 15.00.			
13. .050; .010; .300; .080; 10.000; 25.000.		14. .045.	
15. .125.	21. .999.	27. .11.	45. $21\frac{1}{10000}$.
16. .222.	22. 2.1.	28. 2.09.	46. $121\frac{1}{10000}$.
17. .15.	23. 10.6.	41. $10\frac{9}{1000}$.	47. $1\frac{6}{10000}$.
18. 5.6.	24. .001.	42. $\frac{110}{10000}$.	48. $46\frac{46}{10000}$.
19. .009.	25. .205.	43. $\frac{15}{10000}$.	49. $\frac{5}{10000}$.
20. .809.	26. .400.	44. $\frac{225}{10000}$.	50. $1\frac{9}{1000}$.
			51. $\frac{1}{10000}$.
			52. $\frac{365}{10000}$.
			53. $50\frac{7}{1000}$.
			54. $\frac{44}{10000}$.
			55. $\frac{76}{10000}$.
			56. $\frac{225}{10000}$.

Page 104

- | | | | |
|--------------|---------------|----------------|---------------|
| 1. \$5.80. | 4. 4.03 gal. | 7. \$.023. | 10. 99.78 ft. |
| 2. \$.44. | 5. 89.30 yd. | 8. 24.87 ft. | 11. 1.760 ft. |
| 3. 14.23 mi. | 6. 830.63 mi. | 9. 125.70 gal. | 12. 6.278 mi. |

Page 105

- | | | | | | | |
|---------|---------|----------|----------|-----------|----------|-----------|
| 1. 4.5. | 2. 3.6. | 3. 80.8. | 4. 3.24. | 5. 50.25. | 6. .064. | 7. 3.650. |
|---------|---------|----------|----------|-----------|----------|-----------|

Page 106

- | | | | |
|-----------------|--------------|----------------|-----------------|
| 8. 6.3. | 15. 4.8. | 22. 674.865. | 29. 175.92 ft. |
| 9. 43.5. | 16. 1,028.2. | 23. 230.4. | 30. 551 ft. |
| 10. 1.33. | 17. 402.27. | 24. 15,607.8. | 31. 51 in. |
| 11. 6.3. | 18. 3. | 25. 28.50. | 32. 202.09 mi. |
| 12. 4,292.84. | 19. 10. | 26. 11.025. | 33. \$53.30. |
| 13. 35.1. | 20. 4,825.4. | 27. \$392.288. | 34. 971.472 mi. |
| 14. .54. | 21. .036. | 28. \$8.80. | 35. Yes. |
| 36. 281.875 in. | | | |

Page 107

37. 4,419.15 ft.

Page 108

- | | | | |
|-----------|-------------|------------|------------|
| 1. 3. | 6. 1,967.5. | 11. 25. | 16. 222.5. |
| 2. 201.2. | 7. 11. | 12. 1,365. | 17. 113. |
| 3. 7. | 8. 4,003. | 13. 50. | 18. 67.5. |
| 4. 298. | 9. 119.3. | 14. 1. | 19. 405. |
| 5. 9. | 10. 2,871. | 15. 125. | 20. 312.5. |

Page 109

- | | |
|--------------------|------------|
| 1. Total, \$17.55. | 2. \$2.46. |
|--------------------|------------|

Page 110

- | | | | |
|-------------|-------------|--------------|----------------|
| 3. \$8.02. | 5. \$3.30. | 7. \$25.47. | 9. \$1,046.35. |
| 4. \$11.34. | 6. \$95.75. | 8. \$193.36. | |

Page 111

- | | | | | | |
|------------------------|------------------------|--------------------------|---------------------------|---------------------------|---------------------------|
| 1. .6. | 6. .7. | 11. .50 $\frac{3}{4}$. | 16. 4.13 $\frac{1}{2}$. | 21. 2.12 $\frac{7}{15}$. | 26. 1.19 $\frac{8}{15}$. |
| 2. 4.1. | 7. .03 $\frac{1}{2}$. | 12. .31. | 17. .06 $\frac{1}{2}$. | 22. 2.01 $\frac{1}{2}$. | 27. .85 $\frac{1}{2}$. |
| 3. .21. | 8. .5. | 13. .42 $\frac{1}{2}$. | 18. .43 $\frac{1}{2}$. | 23. 1.31 $\frac{6}{13}$. | 28. .133 $\frac{2}{3}$. |
| 4. .013. | 9. .8. | 14. 1.05 $\frac{1}{3}$. | 19. 2.76 $\frac{1}{4}$. | 24. .04 $\frac{5}{9}$. | 29. .091 $\frac{7}{11}$. |
| 5. .35 $\frac{5}{8}$. | 10. .07. | 15. .52. | 20. 2.93 $\frac{6}{17}$. | 25. .22 $\frac{1}{11}$. | |

Page 112

30. \$2.15.	32. \$.50 $\frac{2}{3}$.	34. .9 cu. yd.	36. \$16.35.
31. \$48.50.	33. 3.6 yd.	35. 30.8 yd.	37. \$9.50.

Page 114

1. $\frac{1}{10}$.	4. $\frac{1}{5}$.	7. $\frac{2}{3}$.	10. 17 $\frac{1}{2}$.	13. $\frac{2}{10}$.	16. $\frac{4}{25}$.
2. $\frac{2}{3}$.	5. 9 $\frac{1}{2}$.	8. 16 $\frac{5}{10}$.	11. $\frac{1}{4}$.	14. 4 $\frac{1}{10}$.	17. $\frac{1}{4}$.
3. $\frac{1}{2}$.	6. $\frac{2}{10}$.	9. $\frac{2}{3}$.	12. 4 $\frac{1}{2}$.	15. $\frac{1}{5}$.	18. 1 $\frac{1}{15}$.

Page 115

1. .4.	4. 1.5.	7. .8.	10. 3.25.	13. .32.	16. .475.
2. .75.	5. .625.	8. .75.	11. .25.	14. 2.56.	17. .44.
3. .24.	6. .18.	9. 1.125.	12. .9.	15. .255.	18. .15.
1. .33 $\frac{1}{2}$.	5. .12 $\frac{1}{2}$.	9. .16 $\frac{2}{3}$.	13. .83 $\frac{1}{2}$.	17. 12.87 $\frac{1}{2}$.	
2. .62 $\frac{1}{2}$.	6. .85 $\frac{1}{2}$.	10. .37 $\frac{1}{2}$.	14. .87 $\frac{1}{2}$.	18. 7.75.	
3. .09 $\frac{1}{11}$.	7. .03 $\frac{7}{11}$.	11. .08 $\frac{1}{2}$.	15. .41 $\frac{1}{2}$.	19. 8.62 $\frac{1}{2}$.	
4. 1.66 $\frac{2}{3}$.	8. 5.83 $\frac{1}{3}$.	12. 2.58 $\frac{1}{3}$.	16. 9.83 $\frac{1}{3}$.	20. 16.66 $\frac{2}{3}$.	

Page 116

1. 70.	4. 80.5 lb.	7. 17 mi.	10. 1 ; 3.	13. \$35.	16. \$6.
2. \$186.	5. 102.	8. 203.1.	11. \$5.10.	14. \$8.	17. \$9.
3. \$15.	6. 12.12 ft.	9. \$14.	12. \$20.	15. \$13.	

Page 118

1. $\frac{2}{3}$; $4\frac{2}{3}$; $18\frac{5}{10}$; $14\frac{1}{10}$; $\frac{2}{10}$; $\frac{1}{2}$; $11\frac{1}{10}$.	3. .9; .06; .8; .008 $\frac{7}{7}$; 1.14 $\frac{2}{7}$; .182 $\frac{2}{7}$.	
2. .6; .5; .875; .28; 5.	4. .66 $\frac{2}{3}$; .75; .87 $\frac{1}{2}$; .08 $\frac{1}{2}$; 2.41 $\frac{2}{3}$; .36 $\frac{1}{11}$.	
5. 85.41 ft.	8. 70.13 ft.	11. 749.07 in.
6. 11.6 bu.	9. 227.52 mi.	12. 9.6 ft.
7. 19.01 gal.; 190.1 gal.	10. \$46.90.	13. 41.1 in.

Page 119

14. \$.50.	15. \$.50.	16. \$1; \$1; \$.65.	18. \$1.60.	19. \$38.22.
------------	------------	----------------------	-------------	--------------

BREADSTUFFS

MEATS

CLOTHING

20. 2d year	\$.083 increase	\$.471 increase	\$.206 increase
3d year	\$2.196 increase	\$.165 increase	\$.855 increase
4th year	\$.70 increase	\$.294 increase	\$.358 increase
5th year	\$1.415 increase	\$.918 increase	\$1.303 increase
6th year	\$.006 increase	\$.524 increase	\$1.226 decrease
7th year	\$5.63 increase	\$2.198 increase	\$.435 increase
8th year	\$3.061 decrease	\$2.359 decrease	\$1.603 increase

21. \$.57.	22. \$9.32.	23. \$4.87.	24. \$1.86.	25. \$3,027.50.	26. \$299.
------------	-------------	-------------	-------------	-----------------	------------

Page 122

1. 20 bbl. 2. 25 bu. 3. 180. 4. 126. 5. 63. 6. $23\frac{1}{4}$. 7. 75.

Page 124

- | | | | |
|-----------------------------|---------------------------|--|-----------------|
| 1. 6 lb. | 4. 392 oz. | 7. 16 lb. | 9. 56 T. |
| 2. $1\frac{1}{4}$ T. | 5. $7\frac{1}{2}$ lb. | 8. 117 lb. | 10. 109,200 lb. |
| 3. 152 oz. | 6. $2\frac{1}{2}$ long T. | | |
| 1. 240 pwt. | 4. 24 sc. | 7. 12. | 10. 1,240 gr. |
| 2. $\frac{3}{4}$ pure gold. | 5. 96 dr. | 8. 120 sc. 40 dr. | 11. 7 pwt. |
| 3. $9\frac{3}{8}$ gr. | 6. 60 gr. | 9. 14,400 gr. troy;
14,400 gr. apoth. | 12. 480 gr. |
| | | | 13. 40. |

Page 127

- | | | | |
|------------------|-------------|-------------------|-----------------------------|
| 1. 3 cords. | 4. 4.58 A. | 6. 7,920 ft. | 8. $272\frac{1}{2}$ sq. yd. |
| 2. 23,040 A. | 5. \$12.96. | 7. 27,648 cu. in. | 9. 3,240 cu. yd. |
| 3. 9,504 cu. in. | | | |

Page 129

- | | | | |
|--|------------------------------------|-------------------------------|-------------------|
| 1. 90° ; 60° ; 45° . | 5. 60° ; 150° . | 8. 90° . | 11. 180° . |
| 2. 45° . | 6. $330''$; $230''$;
3,600''. | 9. 90° ; 360° . | 12. 5,400'. |
| 3. 45° . | | 10. 120° . | 13. 7,200'. |
| 4. 360° ; 180° ; 90° ;
60° ; 30° . | 7. $110'$; $340'$. | | |

Page 130

- | | | | |
|-------------|-----------------|-----------|----------------|
| 1. 258 in. | 4. 3,017 lb. | 7. 28 pt. | 10. $106''$. |
| 2. 66 oz. | 5. 1,824 units. | 8. 52 qt. | 11. 38 ft. |
| 3. 94.5 ft. | 6. 740 sq. rd. | 9. 94 pt. | 12. 90 cu. ft. |

Page 131

- | | | | | |
|------------|--------------------------|-------------------------|----------------------------|-----------------|
| 1. 23 lb. | 5. 364 da. | 9. $36\frac{7}{8}$ da. | 13. $2\frac{7}{8}$ mi. | 16. 592,000 oz. |
| 2. 50 gal. | 6. $6\frac{1}{4}$ gross. | 10. $15\frac{3}{4}$ yd. | 14. 1 cu. ft. | 17. 26,520 hr. |
| 3. 85 bu. | 7. 2 cu. ft. | 11. $\frac{7}{30}$ hr. | 15. $2\frac{3}{4}$ sq. ft. | 18. 2 sq. rd. |
| 4. 1 hr. | 8. $233\frac{3}{8}$ gal. | 12. $6\frac{1}{4}$ yd. | | |

Page 132

- | | | | |
|-----------------------|-----------------------|-------------------------|--------------------|
| 1. 256 lb. 6 oz. | 6. 15 wk. | 10. 126 bu. 2 pk. | 13. 12 gal. 3 qt. |
| 2. 38 gal. 1 qt. | 7. 69 rd. 1 ft. | 5 qt. | 14. 19 mi. 120 rd. |
| 3. 30 yd. 1 ft. 3 in. | 8. 120 gal. 3 qt. | 11. 46 yd. 2 ft. 10 in. | 15. 2 wk. 6 da. |
| 4. 86 mi. 80 rd. | 9. 22 wk. 4 da. 1 hr. | 12. 10 bu. 2 pk. 6 qt. | |
| 5. 63 bu. 1 pk. | 45 min. | | |

Page 133

- | | | | |
|--------------------------------|-------------------------------|----------------------|--------------------------|
| 16. 31 lb. $14\frac{1}{2}$ oz. | 18. 8 rd. $14\frac{1}{2}$ ft. | 20. 58 bu. 4 qt. | 22. 20 yd. 11 in. |
| 17. 45 bu. 1 pk. | 19. 40 gal. 2 qt. 1 pt. | 21. 4 gal. 2 qt. | |
| 1. 298 lb. | 4. 1,012 da. 20 hr. | 7. 7,149 yd. 1 ft. | 10. 4,010 T. |
| 2. 1,012 ft. 6 in. | 20 min. | 8. 2,700 gro. 6 doz. | 11. 35 gal. 1 qt. |
| 3. 548 gal. | 5. 125 wk. 6 da. | 9. 3,979 ft. 3 in. | 12. 366 rd. 13 ft. 6 in. |
| | 6. 93 mi. 2,910 ft. | | |

Page 134

- | | | | |
|------------------------------|--------------------------------------|--|------------------------------------|
| 1. 10 ft. $\frac{2}{3}$ in. | 5. 2 sq. ft. $15\frac{1}{2}$ sq. in. | 8. 41 min. $31\frac{1}{2}$ sec. | 12. 7 gal. 2 qt. |
| 2. 55 lb. $9\frac{3}{8}$ oz. | | 9. 146 sq. rd. | 13. 5 rd. 1 yd. $6\frac{2}{3}$ in. |
| 3. 13 da. 9 hr. 8 min. | 6. 43 yd. 2 ft. 4 in. | 10. $82\frac{1}{2}$ cu. in. | |
| 4. 138 rd. 8 ft. 3 in. | 7. 11 rd. $4\frac{1}{8}$ ft. | 11. 20 rd. 1 yd. 1 ft. $\frac{1}{2}$ in. | |

Page 135

- | | | | |
|-----------------------|------------------------|---------------------------|-------------------------|
| 1. $10\frac{3}{4}$. | 6. $2\frac{27}{144}$. | 11. $5\frac{2}{3}$. | 16. 59. |
| 2. $9\frac{2}{3}$. | 7. $5\frac{3}{16}$. | 12. $4,889\frac{1}{15}$. | 17. $36\frac{2}{3}$ ft. |
| 3. $12\frac{1}{2}$. | 8. $32\frac{1}{2}$. | 13. $9\frac{1}{2}$. | 18. $2\frac{1}{10}$ T. |
| 4. $7\frac{3}{4}$. | 9. 21. | 14. $28\frac{1}{2}$. | 19. 11. |
| 5. $74\frac{8}{11}$. | 10. $2\frac{7}{8}$. | 15. 152. | 20. 145. |

Page 137

- | | | | | |
|---|------------------|-------------------|----------------|--------------------------------|
| 1. 12. | 2. 78.75 sq. yd. | 3. 41.25 sq. ft. | 4. 529 sq. in. | 5. 236.25 sq. ft. |
| 6. 6,000 sq. ft. ; $666\frac{2}{3}$ sq. yd. | | 7. 77,469 sq. yd. | | 8. 2 in. |
| 9. 66 sq. ft. | 11. \$74.75. | 13. \$416.67. | | 15. $1,111\frac{1}{3}$ sq. yd. |
| 10. $195\frac{5}{8}$ A. | 12. 5,280 ft. | 14. 10 rd. | | 16. 3,528 sq. ft. |

Page 138

- | | | | |
|--|----------------------------|---------------------------|----------------------------|
| 1. 6 sq. in. | 2. $13\frac{1}{2}$ sq. ft. | 3. $1\frac{1}{2}$ sq. yd. | 4. $10\frac{1}{2}$ sq. ft. |
| 5. $23\frac{2}{3}$ sq. rd. ; 39 sq. yd. ; $1\frac{7}{8}$ sq. in. ; $14\frac{1}{2}$ sq. ft. | | | 6. 1 A. |

Page 139

- | | | | | | |
|-----------------------------|---------------|------------------|----------------|----------|--------------|
| 1. $\frac{s \times a}{2}$. | 2. 32 sq. in. | 3. 6,768 sq. in. | 4. 221 sq. ft. | 5. \$30. | 6. \$104.76. |
|-----------------------------|---------------|------------------|----------------|----------|--------------|

Page 140

- | | | | | |
|----------------|-----------------|----------------|-----------------|----------------|
| 7. 240 sq. ft. | 8. 1000 sq. in. | 9. 300 sq. yd. | 10. 360 sq. rd. | 11. 28 sq. in. |
|----------------|-----------------|----------------|-----------------|----------------|

Page 142

- | | |
|---------------|------------------------|
| 1. 4 ; 20 yd. | 3. $31\frac{1}{2}$ yd. |
|---------------|------------------------|

Page 143

4. 14 yd. 6. Bedroom, \$.80; dining-room, \$1.60; sitting-room, \$1.20;
 5. \$4.33. total, \$3.60.
 7. \$9 for side walls. 8. 12,096. 9. \$35.88.

Page 144

1. $164\frac{1}{8}$. 3. $419\frac{1}{8}$ loads. 5. $1,012\frac{1}{2}$ cu. ft. 7. 450,000 cu. ft.
 2. \$2,126.67. 4. 750 cu. ft. 6. 5,600 cu. yd.

Page 145

1. 57.75 cu. in. 2. $67.20\frac{1}{8}$ cu. in.
 3. The dry quart is $9.45\frac{1}{8}$ cu. in. larger than the liquid quart.
 4. $1.244+$ cu. ft. 7. 6 times. 9. $1,558\frac{2}{3}$ cu. in.; $6\frac{2}{3}\frac{2}{3}$ gal.
 5. $154.34+$ bu. 8. $66\frac{1}{4}\frac{1}{4}$ cu. ft. 10. $351\frac{1}{4}\frac{1}{4}$ bu.
 6. 585 times.

Page 146

1. 3 cords. 2. 25 cords; 32 cords; 23 cords; 81 cords. 3. \$3.50.

Page 147

1. 40 bd. ft. 6. \$18.69. 10. \$55.
 2. 336 bd. ft. 7. \$15.25. 11. \$39.20.
 3. 2,800 bd. ft. 8. \$30.80. 12. $102\frac{1}{4}$ ft.
 4. $533\frac{1}{4}$ bd. ft. 9. \$48.84. 13. 4,480 bd. ft.
 5. \$8.63.

Page 148

1. \$81.29. 2. 83 cu. yd. 3. $264\frac{1}{2}$ cu. ft. 4. $264\frac{1}{2}$ cu. yd.

Page 149

5. $66\frac{2}{3}$ cu. yd. 6. $354\frac{2}{3}$ cu. ft. 7. 228 cu. ft. 8. 1,512 cu. in.

Page 150

1. 17 yr. 1 mo. 4 da. 3. 67 yr. 9 mo. 22 da. 5. 1,759.
 2. 51 yr. 8 mo. 20 da. 4. 69 yr. 6 mo. 17 da. 6. 56 yr. 2 mo. 2 da.

Page 151

1. 127 gal. 2 qt. 8. 619 T. 908 lb. 10 oz.
 2. 28 bu. 2 pk. 2 qt. 9. 8 bu. 3 pk. 3 qt.
 3. 7 mi. 59 rd. 15 ft. 9 in. 10. 22 gal. 2 qt. 1 pt.
 4. 43 T. 501 lb. 3 oz. 11. 114 sq. yd. 7 sq. ft. 124 sq. in.
 5. 103 sq. yd. 1 sq. ft. 116 sq. in. 12. 269 cu. yd. 1 cu. ft. 808 cu. in.
 6. 483 cu. yd. 21 cu. ft. 204 cu. in. 13. 1 sq. yd. 6 sq. ft. $83\frac{7}{15}$ sq. in.
 7. 9 mi. 32 ft. 1 in. 14. 1,405 yd. $1\frac{5}{11}$ ft.

Page 152

- | | | | |
|--|--------------------------------------|----------------|---------------------|
| 15. 400 sq. ft. | 17. $17\frac{7}{8}$ yd., or 3 strips | 19. 720 A. | 21. 480 bd. ft. ; |
| 16. 890 sq. ft. ; 600 sq. ft. | each 20 ft. long. | 20. 96 ¢. | \$2.88. |
| 23. 7,875 cu. ft. ; \$2,479.17. | 18. 21. | 25. 72 times ; | 22. 640 cu. in. |
| 24. 567 cu. ft. oxygen ; 2,133 cu. ft. nitrogen. | | | $3\frac{7}{8}$ min. |

Page 153

- | | | |
|---|-------------------------|-----------------------------|
| 26. 18 hr. | 30. 128 cords. | 34. 750 cu. ft. |
| 27. $3,141\frac{2}{7}$ gal. | 31. $42\frac{7}{8}$ yd. | 35. $91\frac{1}{2}$ cu. in. |
| 28. $311,114\frac{1}{2}\frac{1}{8}$ cu. ft. | 32. 86,400 sec. | 36. 11 cu. ft. |
| 29. $1,542.8 + \text{bu.}$ | 33. 2,100 min. | 37. 680 cu. in. |
| 38. (1) 1,456 cu. ft. | (2) 4,122 cu. ft. | (3) 3,210 cu. ft. |
| (5) 2,312 cu. ft. | (4) 1,937 cu. ft. | |

Page 155

- | | |
|------------|-------------|
| 9. 285 mi. | 10. \$1.60. |
|------------|-------------|

Page 156

- | | | |
|----------------------|------------------------|----------------|
| 11. \$.80. | 15. 28. | 18. 270,000 T. |
| 12. 78 millions. | 16. 1,700,000. | 19. 990. |
| 13. \$40 ; \$21.33. | 17. 320,000 ; 200,000. | 20. 444 ft. |
| 14. \$8.40 ; \$6.30. | | |

Page 157

- | | | | | | |
|-------------|----------|---------------|----------------------------|-------------------|------------|
| 1. \$39.10. | 2. \$72. | 3. 134,000 T. | 4. $142,105\frac{1}{2}$ T. | 5. 4 rolls ; \$2. | 6. \$1.60. |
|-------------|----------|---------------|----------------------------|-------------------|------------|

Page 158

- | | | |
|-------------|--------------|-------------|
| 7. \$4,050. | 8. \$56,000. | 9. \$3,150. |
|-------------|--------------|-------------|

Page 159

- | | | | |
|-------------------|----------------------------|---------|------------------------|
| 1. 176 cu. ft. | 3. $19\frac{1}{4}$ sq. yd. | 5. 4 ¢. | 7. \$2.56. |
| 2. 47.125 sq. in. | 4. 11 ¢. | 6. 432. | 8. $12\frac{1}{2}$ hr. |

Page 160

- | | |
|---|--|
| 1. \$.017. | |
| 2. Maintenance, \$2,870,000 ; equipment, \$1,629,000 ; transportation, \$5,548,000 ; general expenses, \$454,000. | |

Page 162

2. Mary, $4\frac{1}{2}$ da.; Helen, $4\frac{1}{2}$ da.; Leslie, $4\frac{1}{2}$ da.; Charles, 5 da.; James, $4\frac{1}{2}$ da.
 3. 1st wk., $4\frac{1}{2}$; 2d wk., $4\frac{1}{2}$; 3d wk., $4\frac{1}{2}$; 4th wk., 4; 5th wk., 5; 6th wk., $4\frac{1}{2}$; 7th wk., $4\frac{1}{2}$.
 4. $25\frac{1}{2}$; $21\frac{1}{2}$. 5. $23\frac{1}{2}$.

Page 163

6. $717\frac{1}{2}$. 7. 900,000.

Page 164

1. $\frac{1}{2}$ mi. long; $\frac{1}{2}$ mi. wide. 2. \$96,000.

Page 165

3. 50. 4. \$7,000. 5. 4 ft.

Page 166

3. $.61\frac{1}{2}$.
 4. .25; .4; .2; 1.5; 1; .75; .2; .6. The diagram represents the table graphically. .6.

Page 167

6. .8. 7. 40 ft. 8. 30 ft.; 30 ft.; 20 ft.
 9. A, 20 ft., 15 ft.; B, 20 ft., 20 ft.; C, 20 ft., 10 ft.; D, 30 ft., 10 ft.; E, 20 ft., 20 ft.

Page 168

5. 2,805,153. 6. 46,306.56+ sq. mi. 7. 37.99+. 8. 490.275 mi.

Page 169

9. \$6.75; \$.18 $\frac{1}{2}$; \$.56. 10. \$7.97.
 11. A, $5\frac{1}{2}$ da.; B, $5\frac{1}{2}$ da.; C, $3\frac{1}{2}$ da.; D, $5\frac{1}{2}$ da.
 12. A, $7\frac{1}{2}$ hr.; B, $7\frac{1}{2}$ hr.; C, $4\frac{1}{2}$ hr.; D, $7\frac{1}{2}$.
 13. A, \$7.14; B, \$8.77; C, \$7.13; D, \$9.57.
 14. A, \$1.19; B, \$1.46; C, \$1.19; D, \$1.60.
 15. \$32.61. 16. $19\frac{1}{2}$ hr. 17. $\frac{1}{4}$; $\frac{1}{4}$.
 18. 48,000 lb. copper; 2,250 lb. silver; $2\frac{1}{2}$ lb. gold.

Page 171

1. 30.005. 3. 100.0263. 5. 96.000497. 7. .34346.
 2. 87.025. 4. 408.1879. 6. .00475. 8. .924563.
 1. $\frac{1}{2}$. 5. $\frac{101}{1000}$. 9. $\frac{211}{1000}$. 13. $\frac{19}{1000}$.
 2. $\frac{1}{16}$. 6. $\frac{1}{100}$. 10. $\frac{1}{100}$. 14. $\frac{503}{1000}$.
 3. $\frac{111}{1000}$. 7. $\frac{1}{16}$. 11. $\frac{1}{2}$. 15. $\frac{223}{1000}$.
 4. $\frac{1}{100}$. 8. $\frac{1}{12}$. 12. $\frac{1}{100}$. 16. $\frac{1}{100}$.

Page 172

1. .1875.	5. .88888+.	9. .66666+.	13. .85714+.
2. .46666+.	6. .91666+.	10. .41666+.	14. .45.
3. .7.	7. .36363+.	11. .69230+.	15. .20833+.
4. .24242+.	8. .53333+.	12. .77777+.	16. .9375.
1. 99.342.	2. 76.2911.	3. 45.7722.	4. 51.4084.

Page 173

5. 201.0842.	10. .30720.	15. 6.5667.	19. 6.25 ft.
6. 1.88588.	11. 274.28.	16. .124289.	20. 3.5 ft.
7. 2.362093.	12. .9651.	17. 8.5439.	21. \$.0275.
8. 6.80330.	13. .07605.	18. .35.	22. \$.0095.
9. 2.8174.	14. 491.634.		

Page 175

1. 12.4.	10. 9.039.	19. 485.74.	27. \$2.25.
2. 70.07.	11. 72.09.	20. 36.531.	28. \$3.02.
3. 25.025.	12. 7.75.	21. 769.23.	29. \$444.60.
4. 507.755.	13. 20.736.	22. 2,656.2.	30. 185.25 mi.
5. 94.824.	14. 166,777.5.	23. 374.	31. \$.83.
6. 58.4375.	15. 10,110.10.	24. 35.7035.	32. \$6.69.
7. 39.0625.	16. 745.008.	25. 250.25 sq. ft.	33. 142 ft.
8. 3,699.63.	17. 769.2.	26. 10.5625 sq. yd.	34. 735.18 $\frac{1}{2}$ mi.
9. 55.65.	18. 28.098.		

Page 177

1. .75.	5. 52.9.	9. 798 $\frac{2}{11}$ hr.	13. 8.4.	17. 6.868+.
2. 2.5.	6. .51.	10. 49 $\frac{3}{4}$ hr.	14. 207 $\frac{23}{35}$.	18. 7.003+.
3. 200 $\frac{1}{2}$ q.	7. 6.42.	11. 51.	15. 3,201.	19. .695+.
4. 2,180.	8. 58.	12. 3.02.	16. 9.166+.	20. 273.602+.
21. 5.738+.	24. 40.156+ hr.			27. 200 in.
22. 1.756+.	25. 320 rd.; 154 rd.			28. 7.5 sq. rd.
23. 900 mi.	26. $\frac{1}{2}$ sec.			29. 55.4 mi.

Page 181

1. 40.	5. 79.98.	9. 450.	13. 211.64.
2. 125.	6. 100.	10. 76.8.	14. 224.
3. 920.	7. 1000.	11. 1,200.	15. 86.67.
4. 2,410.	8. 787.5.	12. 720.	16. 384,440 bu.

Page 182

17. \$44; \$220; \$22; \$11. 18. 75 lb.; 3,360 lb.
 19. 648. 20. 40; 40%. 21. \$8,250. 22. 18½ A. 23. 1368.75 T.

Page 183

1. 50%; 33⅓%; 24%; 9⅔%; 10%; 4⅓%.
 2. 33⅓%; 20%; 16⅔%; 14%; 5.6%; 4%; 2%.
 3. 50%; 33⅓%; 16⅔%; 5%; 4⅔%; 14%; 3½%.
 4. 100%; 50%; 12½%; 25%; 19⅔%; 13⅓%; 10%.
 5. 33⅓%; 80%; 100%; 200%; 400%; 800%; 1000%; 1,600%.
 6. 25%.

Page 184

7. 15%. 8. 20%. 9. 23⅓%. 10. 20%. 11. 70%.

Page 185

1. 300. 4. 28. 7. 140 lb. 10. \$1.20.
 2. 500. 5. 60. 8. 60 lb. 11. 4,215⅔ bu.
 3. 150. 6. 300. 9. \$7.33. 12. 8⅔ oz.

Page 186

1. 1.7078. 2. 202.363. 3. 21.4117. 4. .55946.

Page 187

5. 27.046. 9. ⅓. 13. ⅓⅓⅓. 17. .625. 21. .5625.
 6. 13.0099. 10. ⅔⅓. 14. ⅓⅓⅓. 18. .4666+. 22. .7272+.
 7. .836457. 11. ⅔. 15. ⅓⅓⅓. 19. .8333+. 23. .4687+.
 8. 366.606. 12. ⅔. 16. ⅓⅓⅓. 20. .55. 24. .1406+.
 25. 250.974. 30. .004455. 35. .9009+. 40. \$11.25.
 26. 674.928. 31. 1.8551+. 36. 70.1666+. 41. \$6.075.
 27. 838,761.75. 32. 11.0687+. 37. \$4,815.34. 42. \$26.4375.
 28. 213.5567. 33. 1.3317+. 38. 263.1 rd. 43. 8.
 29. .087783. 34. 28,944. 39. 2.159 oz.

Page 188

44. 33⅓%; 2,500,000; 500,000; 800,000; 3,000,000.
 45. Nitrogen, \$.40; phosphoric acid, \$.45; potash, \$.075.
 46. 8 lb.; 8½ lb.
 47. Land surface, 39,603.96+ sq. mi.; water surface, 396.03+ sq. mi.
 48. 9,300 sq. mi. 49. 8 lb. 4 oz.; 18½%. 50. 46.8 lb. 51. 24.5 lb.

Page 189

52. $\frac{1}{2}$; 25%; 18 lb.

	1st	2d	3d	4th	5th	6th
53. Gravel,	25%	27 $\frac{1}{2}$ %	37 $\frac{1}{2}$ %	23 $\frac{1}{2}$ %	16 $\frac{1}{2}$ %	30%
Sand,	41 $\frac{1}{2}$ %	44 $\frac{1}{2}$ %	44 $\frac{1}{2}$ %	42 $\frac{1}{2}$ %	27 $\frac{1}{2}$ %	44 $\frac{1}{2}$ %
Gravel and sand,	66 $\frac{1}{2}$ %	72 $\frac{1}{2}$ %	81 $\frac{1}{2}$ %	66 $\frac{1}{2}$ %	44 $\frac{1}{2}$ %	74 $\frac{1}{2}$ %
54. 16 $\frac{1}{2}$ %.	56. 1.26 $\frac{1}{8}$ T. gravel; 2 $\frac{1}{2}$ T. cement; 4.35 $\frac{1}{2}$ T. sand.	58. 6.2 oz.				
55. 49%.	57. 46.5 oz.	59. 6.2 oz.				

Page 190

59. 26.2 oz.

60. 910; 4,550.

61. .526 lb.; 18.936 lb.

62. Mutton, 3.45 lb.; veal, 3.85 lb.; rice, 2 lb.; eggs, 3.275 lb.; flour, 2.85 lb.

63. Pork, 8.288 lb.; fish, .064 lb.; eggs, 2.976 lb.; rice, .096 lb.; beans, .576 lb.; flour, .32 lb.

64. Beef, 1.69 lb.; mutton, 1.03 lb.; eggs, 1.21 lb.; flour, 7.56 lb.; rice, 7.94 lb.; corn, 2.04 lb.

Page 191

65. 10 ft. 66. 6 ft.; 8 ft. 67. $\frac{1}{2}$ ft. 68. 5 ft. in 100 ft. 69. 5%.70. Rise of 12 ft. in 100 ft.; rise of 5 ft. in 100 ft.; rise of $\frac{1}{2}$ ft. in 100 ft.; rise of $\frac{3}{4}$ ft. in 100 ft.

71. 52.8 ft.; 528 ft.; 633.6 ft.

72. 1 ft.; 2.3 ft.; 3 $\frac{1}{2}$ ft.; 2 ft.; 2.5 ft.; 4 ft.

73. 2.3%.

Page 193

1. 6 $\frac{1}{2}$ %.

4. 36%.

7. 20%.

10. \$1.60.

13. \$1,875.

2. \$4,000.

5. 25%.

8. 33 $\frac{1}{2}$ %.

11. \$7.50.

14. 10%.

3. \$50.

6. 40%.

9. 10%.

12. \$100.

15. 25%.

16. 120 million.

17. 7 $\frac{1}{2}$ million bales, or 3,750 million lb.

Page 194

18. 50%; 25%.

19. Gain, \$250; loss, \$50.

20. \$250.

Page 195

1. \$375.

4. \$570.

7. \$25.

10. \$79.20; 26.4%

2. \$686.

5. \$3,120

8. 4%.

11. \$168.50.

3. 3%.

6. \$150; 5%.

9. \$289.50.

Page 196

1. \$13.50; \$35.

2. \$3.76.

3. \$1.40.

4. 5%.

5. 10%.

6. \$9.

Page 197

7. \$20. 10. \$816.53. 13. \$100. 16. \$1.70. 19. \$5. 21. 25%.
 8. \$7.70. 11. \$10.50. 14. \$53.39. 17. \$7.50. 20. \$1.50. 22. 33 $\frac{1}{3}$ %.
 9. \$4.20. 12. 2 $\frac{1}{4}$ %. 15. \$20.80. 18. \$6.

Page 198

1. \$8. 3. \$28.98. 5. The interest on \$100 for 4 yr. at 5%. 7. \$100.
 2. \$25. 4. \$225. 6. \$1000.

Page 199

8. \$43. 11. 2 yr.; 5 yr.; 3 $\frac{1}{2}$ yr.; 1 $\frac{1}{2}$ yr.
 9. \$6; \$12; \$18; \$24; \$30; \$60; \$93. 12. \$35.
 10. 4 $\frac{1}{2}$ yr. 13. \$550; \$27.50.
 1. \$1,236.25; \$1,505; \$1,881.25. 3. \$379.
 2. \$658.225. 4. \$3,375; \$5,000.

Page 201

2. \$692.50. 3. \$440.625. 4. \$1,722.
 1. \$12; \$4; \$5. 2. \$7; \$11; \$31; \$47. 3. \$24. 4. \$10.
 5. \$18. 7. \$12. 9. \$6. 11. \$22. 13. \$16.
 6. \$4. 8. \$20. 10. \$14. 12. \$8. 14. \$24.

Page 202

15. \$16. 18. \$96.80. 21. \$15.75. 24. \$31.69. 27. \$86.63.
 16. \$33.75. 19. \$24.75. 22. \$95.29. 25. \$6. 28. \$117.
 17. \$168. 20. \$56.25. 23. \$195. 26. \$15.26.

Page 203

1. \$490.30; \$455.30. 2. \$132.87.

Page 204

3. 222. 4. \$195.14.
 1. \$.90; \$90.90. 2. \$2.05. 3. \$1.30; \$131.30. 4. \$504.58.

Page 205

5. \$.79; \$2.14; \$182.93.
 1. \$10. 2. \$7,500. 3. \$18.75; $\frac{1}{4}$ %. 4. \$.012. 5. \$120.

Page 206

- | | | |
|--------------|-------------|------------------|
| 6. \$15,000. | 7. \$1.20. | 8. \$5. |
| 1. \$510. | 2. \$5,000. | 3. \$45. |
| | 4. \$19.95. | 5. \$100; \$190. |

Page 207

7. \$271,867,260.
 8. From liquors; from miscellanies; \$141,189,488; \$179,684,121.
 9. $4.9+\frac{1}{10}$; $19.+\frac{1}{10}$.
- | | | | |
|-------------|----------------------------|-------------|-----------|
| 1. \$29.70. | 3. \$21.52 $\frac{1}{2}$. | 5. \$29.70. | 7. \$120. |
| 2. \$29.25. | 4. \$41.80. | 6. \$66. | |

Page 208

- | | |
|-----------|-------------|
| 8. \$245. | 9. \$55.50. |
|-----------|-------------|

Page 209

- | | |
|-----------|-------------|
| 1. \$300. | 2. \$49.50. |
|-----------|-------------|

Page 210

- | | | |
|---------------------------------|---------------------------------------|--------------|
| 1. \$31. | 3. $10\frac{1}{2}$; \$11.70; \$7.80. | 5. \$20,400. |
| 2. \$20.83; \$145.83; \$395.83. | 4. \$13.83. | |

Page 213

- | | | | |
|-------------|---------------|---------------------------------|-----------------------------|
| 1. \$83.33. | 6. \$142.19. | 11. \$630.63. | 16. $17\frac{1}{3}\%$ gain. |
| 2. \$98. | 7. \$20.83. | 12. \$1,001. | 17. \$33.33. |
| 3. \$30.28. | 8. \$165.21. | 13. $16\frac{2}{3}\%$ gain. | 18. 5.5% . |
| 4. \$30.34. | 9. \$150. | 14. $33\frac{1}{3}\%$ gain. | 19. \$241.92. |
| 5. \$46.40. | 10. \$158.57. | 15. $24.9+\frac{1}{10}\%$ loss. | |

Page 214

- | | | | |
|--------------|---------------|---------------|---------------|
| 20. \$440. | 24. \$56.25. | 28. \$29.75. | 32. \$192.50. |
| 21. \$700. | 25. \$15.75. | 29. \$83.33. | 33. \$88.38. |
| 22. \$650. | 26. \$195.89. | 30. \$548.25. | 34. \$237.86. |
| 23. \$24.75. | 27. \$30. | 31. \$999.96. | 35. \$57.75. |

Page 215

- | | | | |
|--|--------------|---------------|---------------|
| 6. 32.028. | 8. 5.139. | 10. .408. | 12. 9.352. |
| 7. .019. | 9. 1.001. | 11. 400.008. | 13. 82.321. |
| 14. .01; .005; .200; .025; .015; .986; .100. | | | |
| 15. 447,194. | 16. 347,317. | 17. 4,041.56. | 18. 5,174.87. |

Page 216

- | | | | | |
|----------------|---------------------|-----------------------|-----------------------|-----------------------|
| 19. 76,896. | 31. \$62,758.0317. | 43. 02. | 55. $2\frac{1}{2}$. | 67. $\frac{7}{38}$. |
| 20. 179,892. | 32. \$.374656. | 44. 4.10. | 56. $\frac{9}{10}$. | 68. $\frac{3}{14}$. |
| 21. 979,267.2. | 33. \$50,165.65. | 45. 18. | 57. $1\frac{9}{10}$. | 69. $\frac{1}{2}$. |
| 22. .003818. | 34. \$9,082.25. | 46. 1.96. | 58. $1\frac{5}{8}$. | 70. $1\frac{1}{2}$. |
| 23. 199.12. | 35. \$223,429.626. | 47. .50. | 59. $1\frac{9}{10}$. | 71. $\frac{2}{3}$. |
| 24. 17.641. | 36. 63,226.641. | 48. 13.98. | 60. $\frac{3}{8}$. | 72. $\frac{2}{3}$. |
| 25. 165.906. | 37. 59,822.362. | 49. 7,846.222. | 61. $\frac{3}{8}$. | 73. $1\frac{1}{15}$. |
| 26. .009858. | 38. 79,689.50. | 50. 1.980. | 62. $1\frac{7}{10}$. | 74. $\frac{2}{3}$. |
| 27. 799.998. | 39. 3.93. | 51. 693,425. | 63. $1\frac{1}{10}$. | 75. $1\frac{1}{2}$. |
| 28. 15.486. | 40. .01. | 52. 13,676.778. | 64. $1\frac{1}{10}$. | 76. $\frac{1}{2}$. |
| 29. 166.9128. | 41. .01. | 53. .001. | 65. $1\frac{7}{10}$. | 77. $\frac{1}{6}$. |
| 30. .00000864. | 42. 535.27. | 54. $2\frac{1}{10}$. | 66. $\frac{7}{24}$. | 78. $1\frac{1}{17}$. |
| | 79. $\frac{1}{2}$. | 80. $\frac{3}{8}$. | 81. $\frac{2}{3}$. | |

Page 217

- | | | | | |
|-----------------------|---------------------------|------------------------|------------------------|------------------------|
| 82. $6\frac{2}{3}$. | 97. $1\frac{9}{16}$. | 112. $2\frac{1}{2}$. | 127. $11\frac{1}{2}$. | 142. $4\frac{1}{2}$. |
| 83. $3\frac{1}{2}$. | 98. $1\frac{1}{2}$. | 113. $\frac{3}{20}$. | 128. $3\frac{3}{8}$. | 143. $8\frac{1}{2}$. |
| 84. $2\frac{1}{10}$. | 99. $1\frac{5}{8}$. | 114. $\frac{2}{3}$. | 129. $1\frac{1}{2}$. | 144. $3\frac{3}{4}$. |
| 85. $11\frac{1}{8}$. | 100. $1\frac{3}{8}$. | 115. $\frac{5}{16}$. | 130. $13\frac{1}{2}$. | 145. $3\frac{1}{4}$. |
| 86. $29\frac{1}{2}$. | 101. $5\frac{1}{2}$. | 116. $1\frac{1}{17}$. | 131. $8\frac{1}{2}$. | 146. $\frac{40}{10}$. |
| 87. $\frac{1}{4}$. | 102. $2,516\frac{1}{2}$. | 117. $3\frac{3}{4}$. | 132. $9\frac{1}{2}$. | 147. $1\frac{7}{10}$. |
| 88. $\frac{5}{12}$. | 103. $6,350\frac{1}{2}$. | 118. $1\frac{1}{2}$. | 133. $9\frac{1}{10}$. | 148. $7\frac{1}{2}$. |
| 89. $\frac{5}{8}$. | 104. 6,970. | 119. $1\frac{1}{4}$. | 134. $9\frac{1}{5}$. | 149. $1\frac{1}{2}$. |
| 90. $\frac{8}{15}$. | 105. 7,488. | 120. $1\frac{1}{2}$. | 135. $31\frac{1}{2}$. | 150. $24\frac{1}{2}$. |
| 91. $\frac{3}{8}$. | 106. 9,865. | 121. $2\frac{1}{2}$. | 136. $47\frac{1}{2}$. | 151. $5\frac{1}{2}$. |
| 92. $\frac{3}{5}$. | 107. 26,875. | 122. $\frac{2}{3}$. | 137. $7\frac{1}{2}$. | 152. $6\frac{1}{2}$. |
| 93. $\frac{8}{15}$. | 108. $883\frac{1}{2}$. | 123. $3\frac{9}{25}$. | 138. $25\frac{3}{8}$. | 153. $30\frac{1}{2}$. |
| 94. $\frac{8}{3}$. | 109. 5,883. | 124. $1\frac{1}{2}$. | 139. $27\frac{1}{2}$. | 154. $15\frac{1}{2}$. |
| 95. $\frac{5}{10}$. | 110. $\frac{1}{2}$. | 125. $1\frac{1}{2}$. | 140. $14\frac{1}{2}$. | 155. $\frac{1}{2}$. |
| 96. $\frac{2}{9}$. | 111. $\frac{1}{4}$. | 126. $1\frac{2}{3}$. | 141. $4\frac{3}{8}$. | |

156. 15 rd. 4 ft. 1 in.

157. 27 mi. 1 rd. 4 ft. 6 in.

158. 37 gal. 2 qt.

159. 282 lb. 11 oz.

Page 218

- | | |
|---------------------------------------|-------------------------------------|
| 160. 44 sq. yd. 1 sq. ft. 134 sq. in. | 165. 26,093 lb. 12 oz. |
| 161. 72 cu. yd. 25 cu. ft. 92 cu. in. | 166. 312 rd. 4 yd. 2 ft. 6 in. |
| 162. 163 gal. 1 pt. | 167. 1,292 mi. 38 rd. 13 ft. |
| 163. 66 bu. 3 pk. 6 qt. | 168. 1 rd. 6 ft. $4\frac{3}{8}$ in. |
| 164. 373 hr. 31 min. 40 sec. | |

169. $5\frac{1}{2}$.	175. 8.	181. $\frac{51}{100}$.	187. .66666.	193. .46875.
170. 3 lb. 6 oz.	176. One.	182. $\frac{321}{100}$.	188. .625.	194. .27083.
171. $20\frac{1}{2}$.	177. 720.	183. $\frac{100000}{100000}$.	189. .88888.	195. .81818.
172. $3\frac{205}{1116}$.	178. 804.	184. $\frac{20011}{100000}$.	190. .4375.	196. .07812.
173. 4.	179. $\frac{11}{1000}$.	185. $6\frac{1}{2}$.	191. .64.	197. .86821.
174. 36.	180. $100\frac{1}{2}$.	186. $\frac{2000}{10000}$.	192. .22727.	198. .00099.

Page 219

1. 50.7 bu.	5. $29\frac{1}{2}$ yd.; \$28.91.	9. 5.17 hr.
2. 131.25 lb.	6. 60,169 lb.	10. .73 mi.
3. 1020 lb.	7. \$100,000,000.	11. $1\frac{1}{11}$; $\frac{1}{3}$; $1\frac{1}{10}$; $\frac{2}{3}$.
4. 1,200.	8. \$.67 $\frac{1}{2}$.	

Page 220

12. $6\frac{1}{2}$.	19. \$.40; 20%.	25. \$277.75.
13. 60; 100; 340.	20. 5,600.	26. \$6.89.
14. 240; 2,400; 3,840.	21. \$2; \$2.04.	27. \$3.16.
15. 35; 5; 45.	22. \$11.76.	28. \$8.69.
16. 100; 900; 70; 3.	23. \$3.81.	29. 441 sq. in.
17. 150; 300; 600.	24. \$2.33.	30. 558 mi.
18. 200; 400; 160; 10.		

Page 221

31. 231 mi.	37. 33 in.; 10 in.
32. 2,860 lb.	38. 29,885+ in.
33. 153 sq. rd.	39. $76\frac{1}{2}^\circ$.
34. 20 lb.; 100 lb.; 50 lb.	40. 2:3; 1st, \$2,400; 2d, \$3,600.
35. 2 lb.; $1\frac{1}{2}$ lb.; 5 lb.; $6\frac{1}{2}$ lb.	41. 2 ϕ .
36. 185 lb.	42. 480 bd. ft.; \$2.88.

Page 222

43. 12° .	46. $173\frac{1}{2}$ lb.	49. \$105.	52. $26\frac{1}{2}$ yd.
44. $3\frac{1}{2}\%$.	47. 720 A.	50. \$49.40.	53. \$4.67.
45. 36 yr. 4 mo. 23 da.	48. \$100.	51. \$105.83.	54. \$1,476.

Page 223

56. $51\frac{1}{7}\%$; $70\frac{1}{11}\%$; $44\frac{1}{3}\%$.	61. 346.2912 cu. in. of oxygen; 1209.9456 cu. in. of nitro- gen; 9.94% of carbonic acid gas.
57. 435,000,000 bu.; \$22,500,000.	62. 21.12 sec.
58. \$1.37 $\frac{1}{2}$; \$.14 $\frac{1}{3}$.	63. 1.32 sec.; 14.89+ sec.
59. \$6,537.50.	
60. \$2.25.	

Page 224

64. 2 min. 67. 49: 46, or $1\frac{1}{4}$. 71. \$107.136.
 65. 2,033 bricks; \$13.73. 69. 12,000,000 lb. 72. \$5,672,059.
 66. 5,280 ft.; 63,360 ft.; .03 in. 70. 3 min. 25 sec.

Page 225

73. \$111, including ceilings.
 74. San Diego, 1.56; San Francisco, 3.31 $\frac{1}{2}$; Sitka, 8.59 $\frac{1}{2}$; Salt Lake City, 1.75 $\frac{1}{2}$; New York, 3.58 $\frac{1}{2}$.
 75. 40,455 bu. 76. $\frac{1}{4}$.
 77. Two brothers, \$6,000 each; 3d brother, \$2,000; cousin, \$4,000.
 78. $\frac{1}{2}$ sq. ft. 79. $\frac{1}{16}$; $\frac{1}{8}$. 80. 21 $\frac{1}{2}$ lb.

Page 226

81. \$5.52. 84. \$435. 87. 16 ft. 90. 9,600 A.
 82. 12. 85. 17 ft. 4 in. 88. 9 $\frac{1}{2}$ mi. 91. \$1.74.
 83. 847 lb. 86. 25; 25; 75; 75. 89. \$6.25. 92. \$615,485.

Page 227

93. \$12.10. 95. 913+ mi. 97. 42,240 ft. 99. \$124.74.
 94. 12,000 lb.; 6 T. 96. 640 rd. 98. 10,560.
 101. Altitude, 4 in.; area, 12 sq. in. 103. 120°; 150°.
 102. North; west; south; south; west. 104. \$52.08.

Page 228

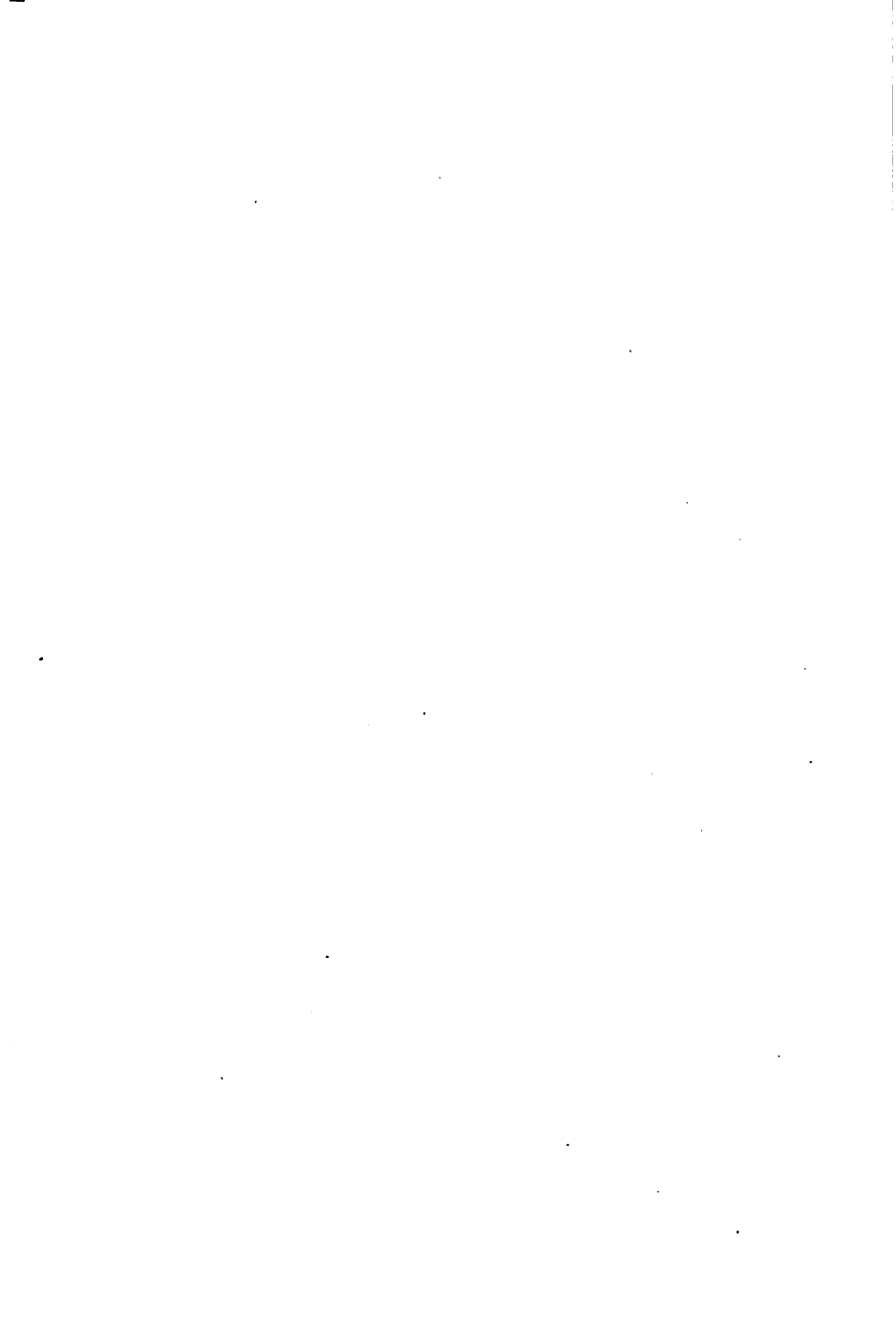
105. \$15.19. 107. \$3.38; \$11.67; \$47.20; \$84.39; \$93.56.
 108. 1,540 da. 110. 7. 112. \$2.03; \$6.97; \$10.17.
 109. 144 cu. yd. 111. \$1.03. 113. \$21.04.

Page 229

114. Cheaper by express. 117. Cheaper by express; \$.12.
 115. Express; freight; freight; freight. 118. \$4.13.
 116. 52 lb. 119. 18 $\frac{1}{2}$.

Page 230

121. \$.001. 123. Deduct 35 $\frac{1}{2}$. 125. 110 ft.
 122. 14,400 ft.; \$14.40. 124. \$18.08. 126. \$.003; \$.018; \$.54.





This book should be returned to
the Library on or before the last date
stamped below.

A fine of five cents a day is incurred
by retaining it beyond the specified
time.

Please return promptly.

**HARVARD COLLEGE
LIBRARY**



**THE ESSEX INSTITUTE
TEXT-BOOK COLLECTION**

**GIFT OF
GEORGE ARTHUR PLIMPTON
OF NEW YORK**

JANUARY 25, 1924

